

CHAPTER III.

FRANCE AND MONACO.

INTRODUCTION.

With over 500 miles of coast line bordering the whole length of the great tidal funnel of the English Channel, an equal extent fronting upon the Atlantic, and a Riviera upon the Mediterranean of incomparable beauty and attractiveness, France offers a field for the development and differentiation of marine biological work unequalled among European states. She has also large maritime interests and fisheries, both local and on the distant shores of Newfoundland and Senegal, of great and growing extent. The scientific work of the French fisheries bureau has not been developed on an independent footing, but has been attached to or associated with existing biological stations and members of the biological faculties of the universities. Add to these factors the highly centralized national system of education, with its practically coequal subdivisions, and finally and principally, the large share which men of scientific interests and training have had in shaping and developing educational policies and practice, and we have the potent influences which have led to the establishment of no less than twenty-six marine or fresh-water biological stations in France.

General public interest and liberal private munificence have also contributed very largely and in most cases made possible the building and equipment of the stations. This is true not only of the imposing Museum of Oceanography, now being built upon the cliffs at Monaco by the Prince of that little realm, with its unrivaled collections and exhibits and superb equipment, but also of its diminutive neighbor at Beaulieu, the striking Moorish villa at Tamaris, the commodious laboratory at Cette, the plain but amply equipped and efficient station at Banyuls-sur-Mer, the pride of the local community at Arcachon—with its annex at Guethary—the rapidly expanding modern station at Roscoff, the new station at Portel, the quaint building at Wimereux, and the extensive plant of the fresh-water station at Toulouse.

At some places, as at Cette and Marseille, the local authorities have also shared in the expense of foundation, and at a few places, as at Nice and St. Vaast-de-la-Hougue, hospitals erected by the state for emergency purposes have been utilized as station buildings. The

state is also a large contributor to the annual budgets of the stations, though the sums granted are inadequate to support so many stations in the proper discharge of their functions.

A factor which has had great influence in the establishment of this large number of stations on the coasts of France has been the idea that a necessary and invaluable part of the instruction in the science of zoology and, to a less extent, in physiology and botany, can be given only at the sea shore in direct contact with the life of the sea in its native environment. The more intimate association of teacher and pupil which exists under these circumstances also enhances the value of the instruction thus given. The two functions of instruction and research are combined in most of the French stations, but the primary, or at least the impelling function of a number of them, as at Marseille, Cette, Luc-sur-Mer, Portel, and Wimereux, is instruction and it is an essential part of the programmes of the stations at Villefranche, Banyuls, Roscoff, Boulogne, Grenoble, and Toulouse.

The stations preeminently equipped for research and making it the sole or primary part of their programmes are those at Roscoff, Banyuls, Monaco, St. Vaast-de-la-Hougue, Villefranche, and Concarneau. The stations at Beaulieu, Tamaris, and Arcachon give no regular instruction and are used mainly for research by their own staffs. Fisheries investigations are regularly and formally carried on at Banyuls, Concarneau, Roscoff, and St. Vaast, and constitute the main programme of the stations at Boulogne, Grenoble, Toulouse, Besse, and Bordeaux.

The hospitality of the French stations is notable. They are, with the exception of Roscoff and Tamaris, open without charge to all comers, without regard to sex or nationality, who are competent to use their facilities. The superb equipment of the new station at Monaco, French in spirit, though politically independent, has been promptly utilized by German, Polish, and Russian investigators. France gives hospitality to the station at Villefranche, under Russian management and support, and largely patronized not only by Russians and French students but also by Swiss and Germans. Her stations elsewhere, especially along the channel, are largely patronized by students and investigators from Russia, Belgium, Switzerland, Scandinavia, and an increasing number of English and Americans. In addition to opening their doors to all, the French stations generally maintain a free biological supply service, furnishing fresh and preserved material to investigators and institutions for instruction and research. The service which France by reason of her strategic position is thus rendering to the cause of the biological sciences and marine research is both effective and far-reaching.

France enjoys the unique distinction of having had the first marine biological station in the world, founded at Concarneau in 1859. This

was followed in 1867 by that at Arcachon, while, in the next dozen years, following in the general wave of advance in biology of that period, led by the untiring efforts of the far-sighted Lacaze-Duthiers, and stimulated in part by the example of Naples, stations followed in rapid succession at Roscoff (1872), Wimereux (1873), Luc-sur-Mer (1874), Marseille (1876), by the private station of Fol and Barrois at Nice, by the French station at Villefranche (1880), succeeded in 1882 by the Russian, Cette (1881), Havre (1882), Banyuls (1883), and Boulogne (1884). Special or institutional interests resulted in the establishment of the stations at Tamaris (1891), St. Vaast (1892), and Beaulieu (1901), and the industrial and economic interests of the fisheries led to the institution of the station at Les Sables d'Olonne and to the fresh-water stations at Grenoble (1901), Toulouse (1902), Bordeaux, and Besse (1893).

MONACO.

INSTITUTE OF OCEANOGRAPHY.

Council of administration:

President, S. A. S. Albert I^{er} de Monaco. Members, Prof. P. Regnard, director of the National Institute of Agronomy; M. Cailletet, member of the Institut de France; Professor Darboux, secretary of the Academy of Sciences; M. G. Kohn, secretary of the Société Industrielles, and M. L. Mayer, private counsel of the Prince of Monaco.

Committee of perfection:

President, S. A. S. Prince Albert I^{er}. Members, Messrs. A. Agassiz (Cambridge), A. Berget (Paris), Prince Roland Bonaparte, E. L. Bouvier (Paris), W. S. Bruce (Edinburgh), J. Y. Buchanan (Cambridge), F. A. Chaves (Azores), C. Chun (Leipzig), Y. Delage (Paris), E. von Drygalski (Berlin), Fabre-Domergue (Paris), F. A. Forel (Morges), V. Hensen (Kiel), H. Hergesell (Strassburg), L. Joubin (Paris), O. Krümmel (Kiel), Sir John Murray (Edinburgh), F. Nansen (Christiania), E. Perrier (Paris), P. Portier (Paris), J. Richard (Monaco), A. L. Supan (Gotha), J. Thoulet (Nancy).

This institute, founded by S. A. S. Albert I^{er}, Prince of Monaco, includes two establishments, the Oceanographical Institute now in construction at Paris, and the Oceanographical Museum just completed at Monaco. The same administrative council and advisory committee have charge of both the institute at Paris and the museum at Monaco, but the staffs of the two establishments are separate and independent.

OCEANOGRAPHICAL INSTITUTE, PARIS.

The institute at Paris, designed for instruction and research, conducts courses of public lectures on subjects relating to oceanography and has at present a small faculty consisting of a professor and préparateur of "Océanographie physique" (Dr. A. Berget and M. Klein), of "Océanographie biologique" (Dr. L. Joubin and Dr. L. Germain), and of "Physiologie des êtres marins" (Dr. P. Portier and Mme.

Gatin-Gruzewska). The researches of the institute at Paris are published in the "Bulletin de l'Institut Océanographique" issued at Monaco.

OCEANOGRAPHICAL MUSEUM OF MONACO.

Founder, S. A. S. Albert I^{er} de Monaco.

Director, Dr. Jules Richard, Musée Océanographique, Monaco, Principauté de Monaco.

Secretary and chemist, Dr. Mieczyslaw Oxner.

Assistant and librarian, M. lic. Louis Sirvent.

Taxidermist, M. Grimm.

Employees: One photographer and amanuensis, three laboratory servants, one machinist, one fireman, one captain, and two fishermen.

Telegraph address: Musée, Monaco.

With the assistance of the Emperor of Germany, the cornerstone of the Oceanographical Museum of Monaco was laid on April 25, 1899. The building was completed toward the close of 1909 and was formally dedicated to its uses the following year in the presence of a representative assembly of scientists from all parts of the world. The institution, magnificently furnished, amply endowed, and dedicated to this field of pure research, is the gift of S. A. S. Albert I^{er}, Prince of Monaco, himself a contributor in a large way to the advancement of science in this field for nearly three decades.

The museum as originally planned was designed merely to hold the rapidly accumulating collections made by the Prince in his numerous cruises in the *Hirondelle* and later in the *Princesse Alice I*, and *Princesse Alice II*. The project grew, however, and as years passed, finally took the form of a general collection of all marine life and an exhibition of the results of oceanographic research and the methods and apparatus employed in its prosecution. In the same building provision is also made for laboratory researches by competent investigators in the fields included in the scope of the museum.

Connected with the scientific expeditions of the Prince in 1888 and continuously since 1891 has been Dr. Jules Richard, the zoologist and oceanographer. As chief of the zoological laboratory on the *Princesse Alice*, scientific secretary of the Prince since 1895, and director of the museum during the years of its development and expansion, Doctor Richard has had no small part in the establishment and upbuilding of the magnificent institution which crowns the brow of the rock of Monaco.

Associated with the Prince in earlier years of his explorations and scientific enterprises, for longer or shorter times, have been Baron Jules de Guerne, Prof. Paul Regnard of the Sorbonne, Prof. G. Pouchet, Dr. J. Y. Buchanan of the *Challenger* Expedition, Prof. K. Brandt of Kiel, and Dr. W. S. Bruce of Edinburgh.

In 1907, Dr. M. Oxner assumed the manifold duties of secretary, hydrographer, and chemist, and has assisted in the rapidly expand-

ing development of the laboratories of the new museum which were first opened for use in 1901. It is greatly to be hoped, in the interests of the cause to which the museum is dedicated, that an increased scientific staff and personnel will make possible a fuller utilization of the superb facilities offered at this institution, with its ample laboratories, large collections, and fine situation.

The affairs of the museum and of the biological station connected therewith are controlled in common by the central committee at Paris, above noted, of which the Prince is chairman. Both are administered directly by the small scientific staff of three members. The entire support is the gift of the donor, who, in addition to the large sums given for running expenses and equipment, has contributed annually over 13,000 francs for the salaries of the scientific staff and 17,000 francs for the pay roll of the labor largely employed in the station features of the work, since the museum is only recently completed.

The station is open without charge to all competent investigators in biological sciences and oceanography. Application should be made in advance to the director, stating full details as to the line of investigation to be pursued, the time of arrival and departure, and a full list of apparatus and chemicals needed. The institution does not provide microscopes but furnishes free a microtome and all other necessaries for laboratory work. Investigators have the use of an ample supply of aquaria, may accompany the *Eider* on its collecting trips, have access to the library and collections, and, by special arrangement, have the use of museum material for research. There are no restrictions as to choice of subject for investigation or place and manner of publication. A half dozen furnished chambers are provided in the building for the use of visiting investigators. It is expected that a circular of information will be prepared for applicants, with full details regarding the conditions under which the laboratories may be used. The excellent facilities so freely offered at Monaco have been promptly utilized by a constantly increasing number of scientists. In 1908 more than twelve visiting investigators carried on researches in the laboratories of the museum, coming mainly from Germany, Switzerland, Russia, and Italy, and giving thus a distinctly international and cosmopolitan aspect to the clientele of the museum.

The museum, independently of the explorations of the *Princesse Alice*, has for several years conducted a programme of hydrographic and planktologic explorations at regular intervals in the neighborhood of Monaco and is preparing a topographic and faunistic map of the adjacent sea bottom. The results of this and other exploratory and faunistic work appear in the "Bulletin de l'Institut Océanographique (1905 + , No. 153 in 1909).

The Musée Océanographique stands in a commanding position high upon the cliff of the great promontory of Monaco. It lies near the eastern end of the beautiful garden of Saint-Martin, not far from the end of the Monaco tramway. The picturesqueness of the location of the museum is enhanced by the fact that it is perched on the steep face of the cliff with its long façade seaward, rising to a height of 75 m. from foundations which reach almost to sea level (Pl. IX, A). Between the archways of the foundations the face of the natural rock remains undisturbed. The main axis runs east northeast by west southwest with the main façade to the north northwest fronting on Avenue Saint-Martin.

The building is an imposing structure architecturally, in the modern French style, the work of M. Delefortrie. It is in the form of a rectangle 100 m. in length, with a central block (20 by 20 m.) and projecting wings (15 by 40 m.). The central block projects and forms the main entrance and vestibule. As seen from the front (Pl. IX, B) it appears to be of but two stories, but the sloping cliff below provides for a basement and subbasement below the level of the street, so that the building has four floors with 6,300 sq. m. of floor area. The main façade is richly ornamented with architectural carvings, some of which, as for example, the globes upon the corner towers, the albatross and fishhawk above the portal, the walrus head in the main gable, and the minor details of shells and ship fittings suggest the purpose of the building. Upon either side of the main portal are allegorical bas reliefs by Dussart; upon the right, "Truth unveiling to Science the Forces of the World;" at the left, "Progress coming to the relief of Humanity." Carved upon the frieze of the building are the names of vessels of all nations which have been engaged in marine exploration, as follows: *Gazelle*, *Investigator*, *Novara*, *Vitiaz*, *Belgica*, *Talisman*, *Valdivia*, *Washington*, *Vega*, *Fram*; *Princesse Alice*, *Hirondelle*; *Pola*, *Blake*; *Challenger*, *Siboga*, *Buccaneer*, *Amelia*, *Ingolf*; *Albatross*. Entering the imposing portal one finds himself in the lofty vestibule whence lead the stairs to the floor above. The vestibule opens directly into the central reception hall, with high ceiling (7 m.) from which open, on the right, a large lecture hall (15 by 40 m.), and, on the left, an exhibition room of similar dimensions. The floor above is likewise wholly given over to exhibition halls, its high ceiling (11 m.) affording room for a gallery likewise containing exhibition cases. On both floors the doors are so arranged that the three halls can be thrown together in one great room (100 m. in length) at times of public gatherings, congresses, etc.

The exhibition rooms are superbly fitted up with metal cases and plate glass and are abundantly lighted by the large, well-distributed windows upon three sides of the rooms.



A. END FAÇADE.

From photograph from Doctor Richard.



B. FRONT FAÇADE.

From photograph from Doctor Richard.

MUSÉE OCÉANOGRAPHIQUE, MONACO.

The roof is double, with intervening air chamber of about 1 m. height to reduce the summer's heat. On the flat top of the building (1,500 sq. m.) is a small roof garden, and on the projecting central section at a slightly higher level is a fully equipped meteorological station. The intention is to make use of the roof (75 m. above the sea level) for the study of currents by means of buoys whose movements can be followed by telescope.

In the first basement, which extends under the whole building, are storerooms, library, publications room, collection rooms, chemical laboratory, offices of director and secretary, and five private laboratories for investigators working upon the collections or for students of oceanographic problems. These rooms can be lighted only from the seaward face and consequently have considerable depth (8.5 m.).

The second basement contains in the western wing a large atelier for the preparation of exhibits, especially for those of large size, as for example, the skeletons or models of cetaceans, seals, etc. It is equipped with a gas motor and other machinery for the mechanical parts of the work. In the recess of the cliff below this floor is a large open room in which are placed the macerating vats for the osteological preparations. One basin is large enough to receive the entire skeleton of a large cetacean.

The eastern wing of the subbasement contains the large aquarium room intended ultimately solely for culture, observation, and experimental work along scientific lines. With the present small staff occupied with the details of equipment and administration of so large an enterprise, no extensive work in these lines has been undertaken. The aquarium room is open to the public, without charge at present. In the future it is planned to erect a public aquarium above the ancient prison to the left of the museum, and devote the present rooms entirely to scientific purposes.

The aquarium room is lighted by three low, wide-arched windows (4 by 4 m.), but its illumination is increased by white walls, and a row of numerous electric lights above the tanks may also be used if necessary. From the dark-walled corridor there may be seen a bank of 9 tanks made of reinforced concrete (Pl. X), with walls 10 cm. in thickness and partitions 6.7 cm., and with inner faces covered with irregular material or artificial stones. The aquaria are 1.6, 2, 1.6, 5.2, 2.6, 2.65, 1.55, 1.45, and 1.45 m. in length, respectively, and have a height of 0.9 m. and a width at the top of 1.35 m. and at the bottom of 1 m., thus giving a slope to the rear face. The water is 0.75 m. deep. A rolling stair at the rear of the aquaria (Pl. X, A) serves for attendance. The openings are glazed with plate glass 23 mm. in thickness. The first plates were set in Portland cement, but later this method has been discontinued on account of breakage, and now

the glass (F) is placed on the front of the aquarium (see figs. 2 and 3) between two strips of pure Para rubber (A), the inner 10 mm. and the outer 4 mm. in thickness. The inner rubber strip rests against a heavy oak bar (B) and the outer against an iron plate (C). Projecting bolts (D) (1.8 by 30 cm.) from the concrete wall (E) pass through the oak bar (4 by 4 cm.) and iron plate (2 by 8 cm.) and bind the whole firmly against the concrete front of the aquarium. A strip of rubber (fig. 3) is also placed beneath and behind the lower edge of the glass, and, on the front, the channel is filled with aquarium cement (G) (Naples formula), with occasional sections (8 cm. long) of Portland cement, at intervals of 0.5 m., to carry the pressure, set in place

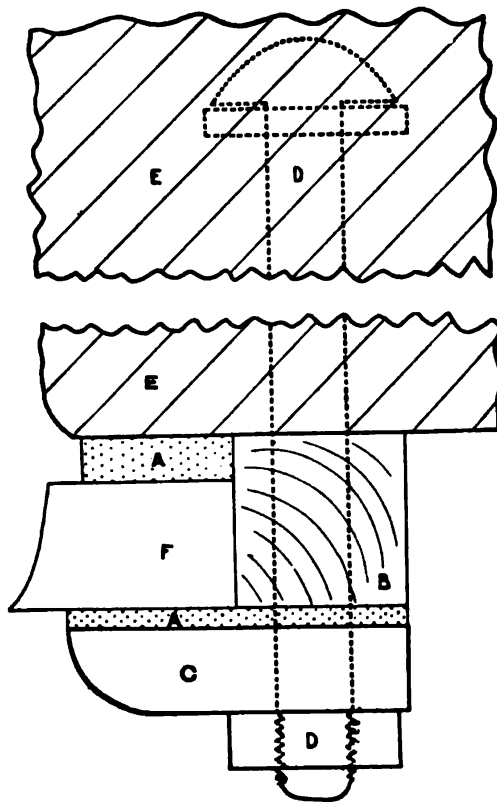


FIG. 2.—Cross section of fittings at end of glazed opening on aquarium fronts, Monaco.

after the aquarium cement is filled in. The upper edge is left entirely free in short sections or in long panes (over 2 m.), is secured by occasional iron L-pins with rubber cushions on their inner face. The aquarium cement on the lower edge is channeled to gather any leakage or drip, and the overflow from the channel is collected in a centrally located outlet (H) and passed to a lead pipe which runs below the front of the aquaria. With the rubber packing there is little or no leakage about the front of the aquaria. The tanks are 1.15 m. above the floor and are guarded by a projecting cement shelf 25 cm. wide.

There are in addition two large tanks, each 3 m. long, 2.7 m. wide, and 1.25 m. in depth with walls 20 cm. thick and with glass 1.38 by 2.65 m. and 30 mm. thick, mounted as in the other aquaria. Adjacent to these tanks there is an open floor tank (3 by 6 m. and 0.6 m. in depth) of reinforced concrete lined with white glazed tile with cement walls 10 cm. thick and side windows 0.3 by 0.7 m. (Pl. XI, B). It is used as a turtle tank and contains three sea turtles (*Thalassochelys caretta*) brought from the Azores, one of them in 1896. There is also a series of six simple cement tanks of rectangular form upon the floor near the windows used as culture basins (Pl. X, B). These are



A. REAR OF EXHIBITION AQUARIA, ROLLING STAIR FOR ATTENDANCE, AND RACK FOR EXPERIMENTAL AQUARIA.



B. THE SAME, SHOWING ALSO THE FLOOR TANKS.

AQUARIUM ROOM, MONACO.

1.1 by 2.1 m. and 0.6 m. in depth, with walls 8 cm. thick. Each has a glazed window 0.3 by 0.7 m. and lead standard for overflow of surface water.

Between these floor tanks and the rear of the large tanks is a long sink table (Pl. X, *A* and *B*) carried by a well-braced iron framework of angle iron. This table serves for many small culture and experimental aquaria. The table top is of reenforced concrete 10 cm. in thickness with rounded rim. It is 1 m. in height and slopes toward the middle, where the overflow from the aquaria upon it is collected and carried away in a lead pipe. The water supply is distributed along its length by curved arms of copper pipe lined with lead rising to a height of 60 cm. at the side of the table.

The aquarium table and laboratories are supplied with numerous small rectangular aquaria of several sizes, 125 by 40 by 60, 64 by 34 by 45, 70 by 34 by 32, 45 by 27 by 30, and 39 by 19 by 17 cm. in length, width, and height, respectively. They are made with metal (iron or brass) frames, on marble or slate bases, or with entire frame of metal and glass bottom. Plate glass of 13 and 8 mm. thickness is used for the sides. Metal parts are protected externally by aluminum varnish and internally by aquarium cement of rubber and tallow, made by saturating melted tallow with pure Para rubber. These aquaria are provided with bottom plug for wash-out and with standpipe for outflow of surface water.

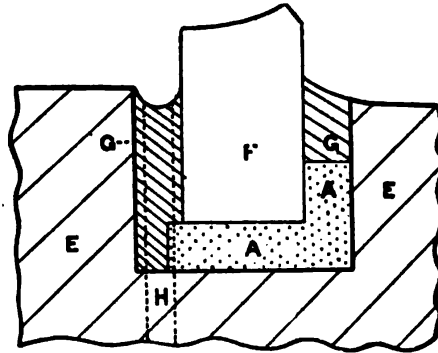


FIG. 3.—Bottom edge glass on aquarium fronts, Monaco.

The pumping plant is located in a small building concealed in the rock at the base of the cliff. There is a triplicate system, two pumps with complete piping to the high-level reservoir, and a third which is connected with the reservoir which receives the outflow from the aquaria for emergency use in case the water from the sea is not available. In the lower pump house there is a 6-horsepower electric motor connected with a 3-cylinder horizontal plunger-pump of special pattern made of phosphor bronze, and a 2-horsepower motor connected with a 3-cylinder vertical brass-lined plunger-pump of Worthington type. The water is drawn from a depth of 2 m. in lead pipes similar to the mains above. The cliff descends abruptly to a depth of 20 m. below sea level affording clear water at the immediate shore and the pipes project only several meters from the wall, ending in a perforated section. The check valves are located in a well at the shore above water level. Mains of 9 and 6 cm. (external diameter) soft lead pipe run from the two pumps to the reservoir of masonry

located in the northern wall of the building at an elevation of 64 m. above sea level and 13 m. above the level of the aquarium room. This reservoir has a capacity of 18 cu. m., and is filled once daily by two hours pumping with the larger pump. The lead mains are carried up the cliff in runs of angle or channel iron which afford the necessary rigidity to carry their weight.

The third pump located below the subbasement on the side of the cliff is a horizontal plunger-pump of phosphor bronze of Japy-Belfort type. It is run by a 2½-horsepower electric motor and has mains of 5 cm. lead pipe connected with a circular reservoir of reinforced concrete 5 m. in diameter and 2.5 m. high, with walls 8 cm. thick and a capacity of 50 cu. m. Water from the aquaria is received here and may be returned to the high-level reservoir if desired.

All the piping in the circulating system, originally of brass, has been changed to soft lead or brass lined with lead. The cocks and valves were of brass, but have been replaced by hard rubber. Mains are of 6 and 9 cm. diameter, laterals of 3.5 and 2.2 and terminals of 1.5 cm. Overflow pipes are of 3.5, 4.5, and 9 cm. and are provided with end and side plugs for cleaning out. The aquaria are supplied with overhead pipes discharging through glass or lead tubes carried to the bottom of the tank and are aerated by air admitted through the rubber connection joining the glass tube to the terminal cock. The outflow is carried off from the surface of the aquaria in three lead pipes set in the wall.

The field equipment of the museum includes a small steamer of 25 tons (gross), the *Eider* (Pl. XII, A). She is 16.5 m. in length, 3.6 m. wide, 4 m. deep, with draft aft of 1.5 m. She has a compound condensing engine of 50 horsepower, and can make 9 knots per hour. Her bunkers hold but 1,500 kilos of coal. She carries a crew of a captain, engineer, and two sailors and has four berths in the forecabin and four aft in the cabin. She is equipped with a 6-horsepower winch in the engine room amidships carrying 5,000 m. of 2 mm. galvanized steel sounding wire for hydrographical and plankton work and 3,000 fathoms of 8 mm. steel cable (not galvanized) for dredging. The breaking strain of the two are respectively 1,800 and 5,400 kilos. The boat carries a full equipment of tow nets, plankton nets, Nansen closing net, Richter reversing thermometers and Richard water bottle, as well as the usual dredges and trawls for bottom work.

The museum is only now entering upon its proper scientific functions and any account of its equipment is necessarily of a preliminary nature. There are at least five investigators' rooms available at present and tables for at least twelve persons, with possibilities of some increase in the number in the near future. The rooms are supplied with fresh and salt water, gas, electric light, and steam heat. There are large investigators' desks, tables with glazed lava tops,



A. MOVABLE AQUARIUM OF LABORATORIES.



B. TURTLE TANKS, WITH TILE LINING.

AQUARIA, MONACO.



aquarium stands (Pl. XI, A) with marble tops, on castors, with hose connections for the waste. These can be moved about into any desired light for experimental purposes.

The laboratories are provided with the common chemicals for biological, hydrographical, and physiological work and a general stock of biological and physiological glassware. There are also thermostats and paraffin baths and a Radaic microtome available for the use of investigators. Ample provision is made for all special needs of investigators when due notice is given in advance.

The chemical laboratory is equipped with Knudsen apparatus for salinity determinations as supplemented by Doctor Oxner for rapid analysis when large numbers of samples are to be examined. With the help of an assistant and these modifications of the apparatus, it is possible to determine thirty samples per hour. This laboratory is provided with water and electric motors, with ventilation hood, and large lava-topped work tables and a considerable quantity of general chemical apparatus.

The biological collections of the museum proper are displayed in rectangular containers of glass with polished fronts, and the objects are arranged upon sheets of white or colored opal glass. The collections illustrate primarily the fauna and flora of the Mediterranean and the territories in the Atlantic, especially about the Azores, the Gulf of Gascony and the Arctic Ocean explored by the ships of the Prince. The collection is not, however, limited to these fields, but in its scope includes all the fauna and flora of the sea, with special reference to that of the pelagic and abyssal areas. The exhibits are in part arranged systematically according to the relationships of the animals and in part in biological assemblages, typical of different regions or types of environment. Fully labeled anatomical preparations of many principal organisms or of special features of morphological or biological significance are also displayed. The collection is specially rich in cetaceans, cephalopods, and the life in the sea at great depths.

A most interesting and valuable feature of the exhibit is the unique collection of models, reliefs, charts, and photographs illustrative of the physics, chemistry, and geography of the sea, and of the ships and instruments employed in its investigation. The collection of oceanographic apparatus is unique in its completeness, including as it does examples or models of practically all known types from the beginning of the period of exploration to the present day.

In addition to the exhibition collection there is also a reserve collection of duplicate material and the beginning of a reference collection of carefully selected and fully named specimens for the use of students and specialists.

The library of the museum contains several thousand volumes dealing with marine biology and oceanography in the widest sense and is in receipt of a number of current periodicals. It is rich in the literature of scientific expeditions, of hydrography and of oceanography, and contains many reprints and separata arranged according to subject.

The museum at Monaco is superbly located in so far as purity of the water is concerned. The shores slope abruptly into deep water, and the promontory of Monaco juts out into the sea for several kilometers, so that the foot of the cliff upon which the building stands is washed with sea water relatively free from sewage contamination. The salinity is subject to very slight fluctuations (chlorine, 20.29 to 21.12). Surface temperatures range from 13° in February and March to 25° C. in August. Tides are slight, as elsewhere in the Mediterranean, with a maximum of 80 cm., affording little opportunity for tide pool or shore collecting. This, combined with the steep and rocky shores, reduces somewhat the opportunity for collecting the littoral fauna.

The sea bottom is varied, affording within a short distance of Monaco a wide range of environment. It slopes to a depth of 300 to 500 m. within a distance of 5 kilometers from shore. A few shallow dredging grounds are available in the neighborhood.

Researches dealing with the local environmental conditions, with the plankton and hydrographical data, and with the distribution of the local fauna are in course of publication or preparation by the staff of the museum. An account of the hydrographical conditions and plankton has been published by Nathanson (1909).

The museum at Monaco offers exceptional facilities for experimental work with living animals in aquaria, for research in hydrographical lines and on plankton problems, while its collections are exceptionally complete in material representing the pelagic and abyssal fauna. With expansion of its scientific staff commensurate with its material equipment it may easily take a leading place among institutions for oceanographic research.

THE PRINCESSE ALICE II.

The Prince of Monaco conducts each year a campaign of oceanographic research in his steam yacht, the *Princesse Alice II*. These campaigns are independent of the museum in support and management, though Doctor Richard, the director of the museum, is also "chef du laboratoire" of the vessel, and the material obtained in these campaigns enriches the collections of the museum.

The *Princesse Alice II*, the successor of the *Hirondelle*, a sailing yacht, and of the *Princesse Alice I*, was built in 1898 especially for the purposes of marine exploration, with the added comforts and

luxuries of a modern pleasure yacht. She is a steel steamer, 73.5 m. long, 10.4 beam, and a draft of 4.5 m., of 1,420 tons gross, with two masts, brigantine rigged, and with a bunker capacity of 245 tons of coal. There are double boilers and a triple-expansion condensing engine of 1,000 horsepower, giving a speed of 13 knots per hour. Her officers and crew number sixty and she has cabin provision for four scientists. A steam winch with two drums is placed forward of the deck house for maneuvering the dredging cable and other tackle. Immediately behind it are two large reels, 2 m. in diameter, driven by electric motor. The starboard reel contains 12,000 m. of dredging cable 14 mm. in diameter, composed of 72 galvanized steel wires arranged in 6 strands of 12 wires each. The cable has a breaking strain of 7,000 kgs. The reel on the port side carries the cable used in connecting the deep-sea traps or "nasses" to the floats which mark their position. This cable is 6 mm. in diameter and is composed of 42 galvanized steel wires arranged in 6 strands of 7 wires each. It is made up in lengths of 500 m. with splice (epissure) connections so that the length of cable may be adjusted to the depth to which the trap is sunk. The floats are galvanized iron buoys, supplemented by rubber air balloons when necessary and carrying a flag or light to make it possible to locate them at sea.

The traps are polyhedral frames of wood covered with mesh and contain guarded funnels for the entrance of fishes and several included traps of finer mesh for smaller crustaceans, etc. These instruments have been remarkably successful in capturing deep-sea and bottom animals in large numbers, especially those freely moving fishes and crustaceans which ordinarily escape the dredge and trawl. It has been used successfully in depths exceeding 5,000 m. and captures great quantities of fishes, etc., taking, for example 1,198 specimens of a deep-sea fish, *Simenchelys parasiticus*, at a single time, a fish not taken in trawling on the same ground.

The ship carries a very complete equipment of otter and beam trawls, drift nets, pelagic trawls, and plankton nets, closing nets of the Monaco (curtain) type and the Giesbrecht pattern as modified by Richard. The equipment for the capture of marine mammals is remarkably extensive, including harpoons, lances, and whale guns of all descriptions. The hydrographic equipment consists of a Le Blanc sounding machine carrying 12,000 meters of 2.3 mm. galvanized steel sounding cable, formed of 9 wires in 3 strands of 3 wires each. The machine is arranged so that the weight of the free wire is carried entirely by the steam winch, which is separate from the reeling drum, the speed of which is adjustable to that of the hoisting drum. Sounding cups of the Buchanan and Leger patterns, thermometers of Chabaud et Hemot and of Richter, and water buckets of Buchanan

and Richard, and bacteriological water sampler of Portier are used on the *Princesse Alice*.

A receiving laboratory is located forward, behind the cable reel on the main deck. It is provided with a large table for sorting, dissecting and serves as an instrument and tackle room, and communicates with the main laboratory below. The main laboratory is lighted by five large portholes and a skylight, and is provided with electric lights. It is furnished with fixed and swinging tables, a large sink with fresh and salt water, lockers for glassware, reagents, books, and instruments, and metal tanks for alcohol. The floor is covered with sheet lead, turned up at the edges to prevent escape of liquids. A large hold for storage is located beneath the laboratory.

The results of the explorations of the *Princesse Alice* and her predecessors appear in a finely illustrated quarto series of monographs of which No. 34 appeared in 1909.

Literature: Nathanson (109), Oxner (1908), Richard (1900, 1900a, 1908).

LABORATORY OF MARINE BIOLOGY OF BEAULIEU.

(École des Hautes-Études, Beaulieu, Alp. Marit.)

Director, Prof. A. Guieysse, Laboratoire d'Histologie, École de Médecine, Paris.
Keeper, Felix Garziglia, Beaulieu.

This little laboratory of marine biology, at Beaulieu, was founded in 1904 by the director and has been equipped and maintained at his personal expense. It is utilized by the director and his associates for their researches and is opened to competent investigators by special arrangement.

It is beautifully located at the water's edge, on the tiny fisherman's harbor, in the "Anse des Fourmis" at the base of the peninsula which separates the roadstead of Villefranche from the Golfe de St. Hospice in the suburbs of the new watering place Beaulieu.

The building is a small masonry structure of one story, located on the fishermen's quay, a few meters from the water's edge and 0.5 m. above sea level, facing the south and west. It contains two laboratories, a main room (6 by 9 m.), well lighted and provided with four work tables with tops of opaline glass (0.6 by 1.25 m.), a central table (1.1 by 2.6 m.), and a bank of five aquaria, each (0.6 m. high, 0.6 m. wide, and 0.9 m. long, with plate-glass fronts 1 cm. thick) set in iron frames. There is also a floor tank of tile and cement (1.4 by 2 m. and 0.68 m. high, with walls 8 cm. thick), with cement table for wall aquaria above. A second laboratory room, also well lighted (3.7 by 4 m.), is provided with work tables and tile-topped work bench (6 by 3 m.). There are also a dark room (1.5 by 2.5 m.) equipped for photographic work and a pump and tank room (1.7 by 2.5 m.).

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The laboratories are handsomely furnished and are provided with gas heaters and fresh and salt water. The equipment includes an assortment of chemicals, reagents, and glassware for biological and bacteriological work, an autoclave, thermostat, water motor, etc.

The pumping plant consists of a three-fourths-horsepower Otto gas motor and an Otto rotary iron pump, with an open circulating system of lead pipes. The mains are 5 cm. and laterals of 3 and 1 cm. external diameter. The aquaria are supplied with overhead pipes and the terminals are of rubber and glass tubing. The outlet is a vertical standpipe with surface overflow. All cocks and valves are of brass. The sea pipe is of lead, opening directly at the water's edge.

The station is provided with a small motor boat (1 by 7 m.), *La Galathée*, with 8-horsepower naphtha motor, for collecting at sea and utilizes the fishing outfit of its fisherman attendant, M. Garziglia, for fieldwork.

A number of local fishing boats make their headquarters at the quay. The immediate neighborhood affords rocky shores, with bottom of sand, gravel, and rock abounding in extensive fields of algæ. The fauna and flora are essentially similar to those at Villefranche and Monaco.

RUSSIAN ZOOLOGICAL STATION AT VILLEFRANCHE-SUR-MER.

Director, Prof. A. Korotneff, Laboratoire Russe de Zoologie, Villefranche-sur-Mer, in January-February, at Zoological Laboratory, University of Kief, Russia. The rest of the year, Villefranche.

Vice-director, Dr. M. Davidoff, resident at Villefranche.

Assistant, Th. Spitschakoff.

In addition, one preparator, two collectors, and one servant.

Telegraph address: Laboratoire Russe, Villefranche-sur-Mer.

The deep, sheltered roadstead of Villefranche-sur-Mer has long been noted as a favorite locality for the marine biologist. It is protected by high cliffs from storms, save only those directly from the south, and the water is blue, clear, and free from contamination. It was here, at the village of Villefranche, that Professor Fol, in 1880, opened, at his own expense, a marine laboratory in the then unoccupied lazaret, a large stone building on the "Darse" or inner harbor, adjacent to the old citadel. After Professor Fol's lamented loss at sea, in 1881, the laboratory was taken over by the French Government in 1882 and Prof. J. Barrois, of the University of Lille, was named as director. The epidemic of cholera, however, in that year brought the laboratory again to its original uses, and it was then proposed to erect a new building for the station.

This project was, however, dropped when the Russian Government, at the suggestion of Professor Korotneff, of the University of Kief, agreed to establish a biological station in a large building, formerly

used by the Russian naval vessels when in winter quarters at Villefranche, as coal depot and repair shop. This permission was supplemented by a grant of funds for the upkeep of the building and support of the station. Professor Korotneff became director of the new station and has since continued in that relation. In 1894 he was joined by Dr. M. Davidoff as vice-director in continuous residence at the station. Under their joint leadership the station at Villefranche has won an enviable position among the stations upon the Mediterranean not only for the richness of its pelagic fauna, but also for the courteous hospitality extended to visiting biologists of all nations.

The director and vice-director are members of the faculty of the University of Kief, in Russia, and the station receives annual grants from the Russian ministries of education and marine affairs. Its facilities are also granted without charge to Russian students, who occupy its research tables in considerable numbers every year.

There is no council or board of control of the station. Its entire administration is immediately in the hands of the director, who also selects the staff. A report of the scientific work in progress, with faunistic and temperature records, and some account of the improvements made at the station is published by the director at intervals of several years in the "Bulletin" of the University of Kief.

The station receives from the Russian ministry of education a yearly grant of 10,000 rubles and from the ministry of war for the upkeep of the property an additional sum of 2,000 rubles. There is also an income of about 600 rubles from the sale of collections. The annual expenditure for salaries of the scientific staff is 5,200 rubles, the director and vice-director being paid in part by the University of Kief; for labor and service, including temporary labor, 1,700 rubles; and for upkeep of building, boats, library, and running expenses, 5,700 rubles. An admission fee of 1 franc is charged for entrance into the recently reconstructed aquarium, and a slight increase in funds is expected from this source in future.

The station has thus no administrative relation to any university or educational institution and has no connection with the fisheries. It has all the autonomy of a private institution, but is wholly devoted to research or advanced instruction.

The institution carries on no programme of investigation and issues no publications. Its staff is occupied with independent research, and its doors are open to all qualified investigators and advanced students for such work as they choose to undertake.

Applications for admission should be sent to Doctor Davidoff in advance, stating the period for which application is made and the material desired for investigation. A copy of the "Reglement" and an outline map of the roadstead and vicinity are supplied on application. The laboratory is open throughout the whole year and at a

maximum provides for 30 workers at once. It is visited annually by 30 to 35 investigators, mainly Russians and Germans, with a few from Switzerland, Austria, and France. It is most crowded in March and April. The best season is fall to spring. The summer months are apt to be warm. Villefranche is well supplied with hotels, and pensions and special rates may be obtained by workers at the station. There are 13 simply furnished chambers in the upper story of the building available gratis on application to the vice-director.

For several years past a practical course in marine zoology for advanced students has been offered in March and April, with occasional lectures in German or Russian. The programme includes the following subjects: *Radiolaria*, fertilization, and cleavage of sea urchin egg, *Cœlenterata*, anatomy of *Echinodermata*, *Nemertina*, *Polychæta*, *Heteropoda*, *Pteropoda*, and *Tunicata*. This predominance of pelagic subjects is characteristic of the rich resources of the station in this field. An honorarium of 50 francs is charged to those attending the course. Students are expected to bring their own microscopes.

Investigators are provided with research privileges, including research table, the supply of living material, and the usual chemicals and reagents, and the use of microtome for a fee of 50 francs per month. Glassware taken away and excessive use of alcohol and expensive reagents are charged at cost of material. The fee may be remitted by the director in exceptional cases. Persons working at the laboratory may make collections for research purposes, but not for university or museum collections. The station issues a price list of animals furnished for exhibition collections, which includes much choice pelagic material.

The grounds of the Villefranche station are located about midway on the western side of the roadstead of that name, immediately beyond the barracks of the French army, just below the Nice-Monaco tramway, and about 1 kilometer from the railway station. The grounds (about 1,000 sq. m.) adjoin the Boulevard des Casernes, and contain, besides the main building, the porter's lodge and dwelling, the old forge and coal depot of the Russian navy, a court, and two small gardens.

The building itself is a plain and somber structure (Pl. XII, B) of two stories and basement, with its long axis running north and south. It faces the roadstead and stands only 3 to 4 m. from the beach and 1 m. above high tide. It was originally used as a prison during the Piedmont régime and later as a naval warehouse. In spite, however, of its nonpromising exterior and lugubrious history, it lends itself admirably to the uses of a biological station. It is a massive masonry structure of rectangular form (9.2 by 35 m.), with corner watch towers now partly removed. (See Pl. XIII.) It originally had a long central corridor (3.2 by 35 m.), with massive

arches in two stories separating long apartments (2.5 by 35 m.) upon either side, while a third even more massive one formed the substructure beneath.

In the present building the central corridor (Pl. XIII), entered from the garden through the vestibule, is two stories (15 m.) in height and still occupies the center of the larger part of the building, and affords access to the working rooms and to the stairs to the second floor, while it also serves as the exhibition hall for the public aquaria, its dim light giving a grotto effect to the room.

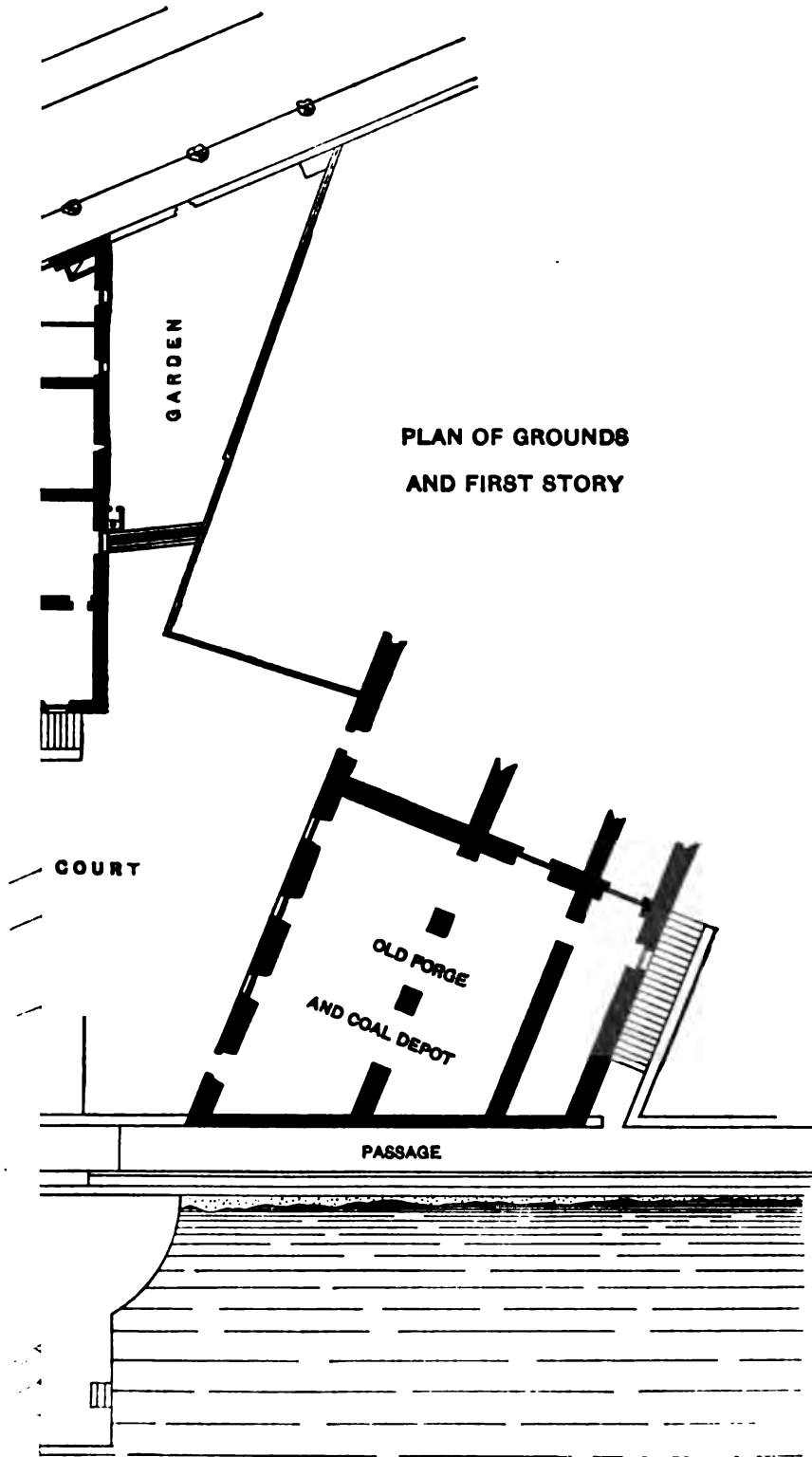
The long apartment upon the seaward side has been broken up into a series of rooms (1, 2, 5-12, Pl. XIII), each including one or two of the structural units (2.5 by 2.5 m.) formed by the arches. Three of these (5, 6, 10) serve as office and laboratories for the director and vice-director and the others as investigators' laboratories. One room (2) is especially designed as a general laboratory for more elementary work. The corner room at the north (1) is an aquarium room for the reception, care, and distribution of the pelagic collections, which are brought daily to the laboratory in the morning during the season. The investigators' rooms are simply furnished with work table (0.8 by 2 m. and 75 cm. high), sink with fresh and salt water, aquarium table (45 by 20 cm.), bookshelves, and several work tables. Gas is supplied to each room, and several of them have paraffin ovens.

At the northern end of the building is a roomy library (3.2 by 6 m.). The side of the building facing the hill is given over to the large attendance room (14, Pl. XIV, A), two stories in height, of the exhibition aquarium, which is also used for culture aquaria for investigators. Adjacent to the vestibule are the glassware room (15, Pl. XIII; 2.5 by 2.5 m.) and the preparation and reagent room (4, Pl. XIII; 2.5 by 2.5 m.), and beyond these the museum (3, Pl. XIII; 5 by 5 m.), with exhibition cases about its walls containing a large collection of carefully mounted and fully labeled specimens of the local fauna, principally invertebrates. The representation of the pelagic fauna is exceptionally fine, and includes choice specimens of medusæ, *Siphonophora*, *Heteropoda*, *Pteropoda*, *Cephalopoda*, *Tunicata*, and some fishes.

The upper floor contains the living quarters of the assistant and of the fishermen, and upon the side facing the bay the chambers available for workers at the station and extensive storerooms.

The engine and pump room are in the basement, and here also is found the low-level storage reservoir.

The library contains a fair number of the useful monographs and general works on marine zoology and the reports of the *Challenger*, *Valdivia*, *Belgica*, and other expeditions. It receives over 75 current biological periodicals, and has a number of complete sets, as well as



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a considerable collection of author's reprints. There are about 3,500 volumes with full card catalogue.

At one side of the main hall is a row of nine aquarium tanks of various sizes made of reenforced concrete with walls 8 cm. thick. There are two large rectangular tanks, one 1.2 m. high, 3.55 long and 1.1 wide, the other 1.2 by 3.55 by 1.2 m., each divided into two aquaria. The remaining four tanks have sloping backs (about 50° from the perpendicular) and are used for sessile animals. Two of them are 2 m. wide at the top and 1 m. at the bottom, and the other 1 m. wide at the top and but 10 cm. at the bottom. The walls are coated with artificial rockwork. The openings (1.15 by 2.75, and 1.1 by 1.6 m.) are glazed with plate glass 27 mm. in thickness mounted in the older aquaria against the inner face on iron frames with minium aquarium cement. In the fronts recently renewed the Monaco method of mounting on the outer face is employed. On the fronts of the aquaria runs a projecting shelf 40 cm. in width of artificial stone work reaching to a height of 1.2 m. from the floor, at the level of the bottom of the aquaria. A wide (4 m.) corridor behind the aquaria with two series of windows and large skylight shielded by adjustable curtains furnishes abundant overhead light to the aquaria. The exhibition corridor itself is but dimly lighted. In the rear corridor are five iron stands (Pl. XIV, A) with two aquaria each in iron frames with plate glass (7mm.) sides and bottom, the upper one 15 by 22 by 42 cm., the lower 21 by 21 by 48 cm. in height, breadth, and length, respectively; each has overhead water supply and vertical standpipe with surface outflow. On the floor is a semicircular basin 1 by 2.6 m. and 25 cm. deep of reenforced concrete with walls 6 cm. thick. This receives the outflow of all the aquaria and is used for storage. In the smaller well-lighted aquarium room are two large tanks (Pl. XIV, B) in iron frames on a cement table 48 cm. high, 61 cm. wide and 165 cm. long with plate glass sides 20 mm. thick. The table has top and uprights of reenforced concrete 9 cm. thick with a floor basin (87 by 156 and 33 cm. high). There is an overhead water supply and standpipe outlet. There is also an elliptical floor basin (1.5 by 1.8 and .25 m. high) with central fountain and walls of reenforced concrete 6 cm. thick.

The circulating system is of lead piping throughout. The mains are 6 cm., the laterals 3 cm., and the terminals 1.8 and 1.2 cm. outside diameter. A hard rubber tip is fastened with rubber tubing at the end of each supply pipe. This is provided with a removable tip with openings 1 to 3 mm. in diameter and is fastened on with rubber tubing perforated for ingress of air. The discharge is carried to the bottom of the aquarium in glass tubing. Each aquarium has its own overflow of 2 cm. lead pipe and a bottom flush of 3 cm. piping. The

outflow mains are of 5 cm. pipe. All cocks and valves are of brass, tinned (in part) on the inside.

The pumping plant consists of a 3 horsepower electric motor and a Jaegar rotary pump of phosphor bronze with a $\frac{1}{2}$ horsepower hot-air pump of Böttger in reserve. The water is drawn from the surface at the margin of the quay through a 4 cm. (internal diameter) lead pipe 28 m. long. The water for the exhibition aquaria is pumped to a cylindrical reservoir (diameter 3.8 m., height 2.62 m., capacity 28 cu. m.) of reinforced concrete with walls 6 cm. thick, located in the central hall in the second story, at an elevation of 15 m. above the pump. The water for the laboratory circulation is pumped to a similar tank (diameter 3 m., height 2.8 m., walls 6 cm. thick, capacity 18 cu. m., elevation 18 m.) in the open air on the corner tower. Waste water from both systems is passed to a basement storage tank 3.8 by 9.25 m. and 1.17 m. deep with masonry walls 40 cm. thick. The system of circulation is closed and the water is used for periods of about ten days before renewal. The shore waters in the roadstead are quickly rendered turbid by shore deposits in rough weather, necessitating a closed system. The laboratory and aquarium circulation are connected but may be used independently.

The Villefranche station is equipped for morphological and observational work, but has no special apparatus for hydrographical (chemical), physiological or bacteriological investigation. There are several high-grade microscopes, six microtomes of Jung, Leitz, and Becker pattern.

The station is fortunate in the possession of a modern motor boat, The *Vellera*, of 7 tons capacity, length 11 m., width 2.8 m., draft 1 m., with a 6 horsepower naphtha motor. She is a kedge-rigged wooden boat with sail large enough for independent navigation and small closed cabin amidships and forward. The equipment consists of two hand winches with 2,000 m. each of 2 mm. and 5 mm. galvanized steel cables for sounding and dredging. The tackle includes the usual tow nets and dredges and a Chun-Petersen closing net, a Nansen closing net, and Negretti-Zambra reversing deep-sea thermometer. The station has also several small boats for shore work.

The temperatures, salinities and tidal conditions are essentially like those at Monaco as is also the character of the shore and bottom, but there are wider stretches of shallow water. A considerable extent of shallow rocky and weedy bottom up to depths of 100 m. is found in the roadstead itself. The shores are everywhere steep and rocky and near the mouth of the bay the water deepens quickly to 500 m. and reaches over 1,000 m. within 5 kilometers from the shore.

The pelagic fauna at Villefranche is especially rich, many forms (e. g., *Histiotuthis* sp.) known elsewhere only from deep waters



**A. SERVICE CORRIDOR OF EXHIBITION AQUARIA WITH FLOOR TANK AND SMALL AQUARIA
IN IRON STANDS.**



**B. TABLE AQUARIA WITH FLOOR TANK IN AQUARIUM.
ZOOLOGICAL STATION AT VILLEFRANCHE.**

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having been taken here at the surface. The pelagic fauna is most varied and abundant in the colder months of the year.

The climatic advantages of the French Riviera, the superb pelagic fauna, the pure water and the roomy laboratories at Villefranche are great attractions to the biologist wishing to work upon plankton problems or upon experimental work where close approach to natural conditions is essential.

Literature: Davidoff (1896), Davidoff and Korotneff (1897), Korotneff and Davidoff (1901), Davidoff and Garyeff (1906, 1907), Jean (1894), Francotte (1907), Gruvel (1898), Sand (1897).

INSTITUTE OF MARINE BIOLOGY OF THE UNIVERSITY OF LYON, TAMARIS-SUR-MER (VAR).

Director, Prof. Raphael Dubois. Laboratoire de Physiologie, Université, Lyon, April-September. At Tamaris the remainder of the year.

The corner stone of this station was laid in 1891, and the building was completed in 1900, on ground given by Michel Pacha, general administrator of the Ottoman light-house service and resident of Tamaris. The University of Lyon granted a sum of 42,000 francs for the building, and subventions have been received from the Department of Var; the commune of Seyne-sur-Mer, in which Tamaris is located; the French ministries of marine and public instruction; the French Association for the Advancement of Science; the Society of Friends of the University of Lyon; the founder, Professor Dubois; and numerous private donors. The laboratory also inherited the library, collections, and equipment of the earlier laboratory of Professors Fol and Barrois at Villefranche. The equipment for the laboratories was furnished by state funds.

The laboratory is an annex of the chair of physiology at the University of Lyon and is occupied by Professor Dubois from September to April, being closed during the warm season.

The station, with adjacent garden, lies on the Rue de la Sablettes, which runs along the water front from the steamer landing at Tamaris. It is readily reached by small steamers, which make hourly trips from the Quay de Cronstadt in Toulon to watering places along the Bay of Toulon. Tamaris lies on the northwest shore of the Rade de Lazaret, opening to the northeast into the Grande Rade du Toulon.

The building stands about 10 m. from the water front and 1.5 m. above high water. It is rectangular in form, with its long axis running north and south, and faces the east. It is a Moorish structure of two stories, built of masonry, elaborately ornamented and decorated, forming a prominent feature in the landscape of the picturesque shore.

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The northern half of the building (9 by 35 m.) is given up to the scientific laboratories and the southern to the quarters of the attendant and the residence of the director. On the ground floor is a collection room (6.5 by 8 m.) containing a small (mostly unnamed) collection of the local fauna, especially of lamellibranchs, and a library of about 500 volumes, mainly French journals and works on physiology. Adjacent to this is a physiological laboratory (6.5 by 6.5 m.) equipped with a chemical hood, balances, thermostat, autoclave, manometer, mercury pump, operating table, and considerable apparatus of simple types for work in electro-physiology. There is also a paraffin oven, a rocking microtome, and a Berthiot micro-photographic apparatus, with adjacent dark room. A receiving room (3 by 2 m.) is used as storeroom for nets, dredges, and fishing tackle, of which the station possesses a simple equipment. Between the library and laboratory is a small (2 by 3 m.) reagent and balance room.

On the upper floor is the study of the director and three small laboratories about 2 by 3 m., each simply furnished, with work tables and sink. Adjacent are two chambers available for workers.

In the garden of the institute is an animal house for rabbits and guinea pigs and an aquarium house (5.4 by 6.5 m.), with adjacent pump house (2 by 7 m.), with a Niel gas motor and a brass plunger-pump. In the aquarium house are a cement reservoir, four floor tanks of cement (one with heating apparatus), and numerous culture basins of glass, marble, and galvanized iron. The circulating system is of lead, with brass cocks and valves.

In front of the station, on the shore, is a small oyster park about 10 by 35 m., inclosed with stone wall, for experimental culture work with oysters and other invertebrates.

The station has three boats for field work.

Application for admission should be sent to the director. A fee of 50 to 60 francs per month is charged for lodging and the use of a private laboratory. In certain cases free admission will be granted.

The investigations carried on at the laboratory are published in the "Annales de la Université de Lyon."

Literature: Sand (1897), Caullery (1899).

MARINE ZOOLOGICAL LABORATORY OF THE UNIVERSITY OF AIX-MARSEILLE (LABORATOIRE MARION) AT ENDOUME, NEAR MARSEILLE.

Director, Prof. Et. Jourdan, Laboratoire de Physiologie, École de Médecine, Université, Marseille; residence, 8 Rue de la Bibliothèque.

In addition, one keeper, a machinist, and a collector.

The station at Marseille owes its origin to the efforts of Prof. A. F. Marion, the distinguished naturalist of that city, for many years the director of its Natural History Museum and professor of zoology in

its faculty of sciences, with which he was connected throughout his academic career. In 1872 a small marine laboratory was opened in the Allée de Meilhan, with Doctor Marion as director. Advanced to the chair of zoology in 1876, he threw his whole soul into building up the Marseille station. The years from 1876 to 1882 were brilliant years for the laboratory, being marked by the presence of a group of Russian, German, and Spanish savants, led by the noted Russian embryologist Kowalewsky and by many French students, who carried on their researches for their doctorates under Marion's guidance and inspiration. In 1888 the crowded quarters of the old laboratory were replaced by a modern building at Endoume, erected by the city on ground belonging to the university.

The investigations of the earlier years of the laboratory were published in a series of monographs in the "Annales" of the Marseille Museum. In later years the work of the laboratory was directed largely toward the solution of practical problems of the fisheries. At present the station is used largely for elementary and advanced instruction and provides the laboratories for university classes in zoology and biological chemistry.

Upon the death of Professor Marion in 1896, Prof. Et. Jourdan, professor of physiology, was made director. Associated with Professors Marion and Jourdan as assistant director was Dr. Paul Gourret, after whose death, in 1903, Dr. P. Stephan was called to the post. The vacancy created by Doctor Stephan's death in 1908 has not been filled.

The Marseille station receives 4,000 francs per annum from the university for the upkeep of the building and equipment of the laboratories and 2,000 francs from the city for the maintenance of the aquaria and collections.

The Marseille station is open throughout the year to properly qualified investigators. No charges are made to savants, but students are expected to conform to the university regulations regarding fees (30 francs annual fee and 50 francs per trimestre for research) and admission. All laboratory facilities, instruments, reagents, and material for research are provided in so far as the equipment and budget of the laboratory permit. Application should be made in advance to the director. The station maintains no biological supply department.

The Marseille station is located in Endoume, a suburb of the city on the coast about 3 kilometers southeast of the "Vieux Port," whence it is reached in a half hour by the Bourse-Prophete tram on the famous Promenade de la Corniche. Descending from this on the Martin Cascade we come to the Rue de la Douan, upon which the laboratory is located in irregular grounds of small extent immediately upon the sea front.

The building (23.5 by 40.5 m. in extreme dimensions) is cruciform in shape, with the long axis running northwest by southeast, with the right transept in the form of a round tower. It stands fronting the sea about 25 m. above sea level and about 35 m. from the rocky face of the cliff. It is a masonry structure built of local rubble and trimmed with cut stone, three stories in height, except for the nave, which has but two stories. A basement room extends for a short distance under the outer end of the nave and projects beyond it as a one-story structure on the sloping face of the cliff upon which the building stands.

The basement room (9 by 13.5 m.) contains a large low-level storage reservoir and serves also as a storeroom. The left wing of the transept (5.5 by 8.5 m.) at the basement level opens upon the adjacent garden, and, with the corresponding part of the first floor, contains four rooms of the living quarters of the keeper and machinist.

The right wing of the transept (7 by 9 m.), terminating in a circular tower (7 m. in diameter) with bastions, contains the stair well and stairs, and on the third floor the salt-water reservoirs.

The first floor contains in the center of the transept a large vestibule (4 by 7.5 m.), whose walls are hung with models of tackle and apparatus used in the local fisheries and for biological collecting. Adjacent is a small storeroom (1.5 by 5 m.), used for tackle, nets, etc. The nave of the ground floor is entirely given up to the room (8.5 by 20 m.) for the exhibition aquaria and to the display of collections, models, and apparatus pertaining to marine work and the fisheries. Beyond the vestibule at the opposite end of the building is the room (8 by 8.5 m.) now used as the laboratory of biological chemistry of the university.

The second story contains, in the left transept, the private physiological laboratory (5.5 by 8.5 m.) of the director, and in the nave the laboratory (6.5 by 8.5 m.) for the courses, and two (each 6 by 6.5 m.) for Professor Darboux and his assistants of the department of zoology of the university. An adjacent corridor and the centrally located vestibule contain exhibition collections of the local fauna, carefully mounted and labeled. There are also a dark room for photography (1.5 by 4 m.) and a well-lighted library (6 by 8.5 m.), with portraits of Marion, Gourret, and Stephan, with adjacent office of the director (2.5 by 5 m.).

The third story includes only the transept and the apse, the roof of the nave forming a protected terrace (8.5 by 9.5 m.) commanding a magnificent view of the Gulf of Marseille. On this floor is a room (5 by 5 m.) equipped with apparatus for photographing living animals, and also for microphotography, with dark room adjacent. A small laboratory (2.75 by 5 m.) is set aside for physiological work, and two others of the same size and a third (5 by 5 m.) somewhat larger are available for visiting naturalists. These laboratories are simply fur-

nished with work table, shelving, and sink, and are supplied with gas and fresh water, but not with aquaria or salt water.

The aquaria of the laboratory are located on the ground floor and form a covered darkened arcade (Pl. XV, A) (4.4 by 10 m.) with central passageway 2.25 m. wide with a bank of six aquaria upon either side. The tanks rest upon an arched structure of masonry with marble top 1 m. high and 0.9 m. wide, with cement drip basin beneath.

The tanks have marble base, back, and partitions, held together in cast-bronze frames (about 5 by 7 cm.) on the angles. The marble and glass are set in litharge aquarium cement. The tanks are rectangular in form and are all of the same size, 1.65 m. long, 0.80 m. wide, and 0.78 m. deep and capacity of 1 cu. m. each, with plate glass fronts 80 by 160 cm. and 30 mm. thick.

A varied assortment of animals representing the local fauna is kept on exhibition, principally small fish, actinians, crustaceans, mollusks, tunicates, and echinoderms. The aquarium is open to the public without charge on Sundays and holidays, and on other days on application to the keeper.

The pumping plant is at a level of 7 m. above the sea and consists of a three-fourths-horse power Blanc gas motor and a Lavigne direct-action plunger pump of brass with adjacent copper strainer and connecting pipes of the same material. The sea pipe (5 cm. outside diameter) is of hard lead 12 m. in length to the pump and 80 m. thence to the reservoir at an elevation of 35 m. above sea level, in a lead pipe of 8 cm. diameter. The reservoirs are 6 in number, containing 1 cu. m. each of masonry lined with marble slabs. The distributing system is lead piping with mains 5 cm. and laterals of 3 cm. The terminals are of lead-lined copper pipes 1 cm. in diameter. The cocks are of bronze throughout. The aquaria are supplied with water from above and discharge through glass tubing carried to the bottom, with orifice for admission of air in the rubber connections. The outflow is drawn off at the surface in two 3 cm. lead pipes set at different levels in the rear wall of the aquarium and connected below with glazed tile, which carries the discharge into the storage reservoirs in the basement. The tanks are also provided with bottom flush plugs. The basement reservoir (3 by 6 m. and 1.8 m. deep) is used for large animals and for reserve stocks of material. It discharges directly to the sea, the water being used but once in the aquaria.

The Marseille station being also the zoological laboratory of the university has a complete equipment for morphological work. The physiological equipment of the university is, however, at the medical school. There is no equipment of hydrographical apparatus. The field equipment consists of a small sailboat and a fair supply of dredges, trawls, nets, tow nets, fish traps, etc., for routine collecting.

The library contains several hundred volumes of special works and serials dealing with marine zoology, and may be supplemented by that of the university and the museum in the city.

The local conditions are not very different from those at Villefranche save that the coast is more densely populated and the otherwise clear blue water somewhat contaminated by sewage. The shores are steep and rocky, affording little shelter for boats and no extensive flats for shore collecting. The bottom fauna is, however, rich and varied. A very full account of the fauna and its local distribution is given in the first memoir of the "Annales du Musée d'Histoire Naturelle de Marseille" by the founder of the station, Professor Marion.

Literature: Dean (1894), Gruvel (1898), Jourdan, Vayssiere et Gastine (1897), Sand (1897).

ZOOLOGICAL STATION OF CETTE (HERAULT).

Director, Prof. O. Duboscq, Laboratoire Zoologique, Université, Montpellier (Herauld), France; professeur de zoologie, Université, Montpellier.

Vice-director, Dr. L. Calvet, Montpellier.

Preparator, Lic. Sci. B. Collin, Cette.

Collector and keeper, B. Marquès.

The station at Cette had its origin in the need of the University of Montpellier for field headquarters at the shore for its teachers and students in zoology, and owes its foundation and development to the untiring efforts of Prof. Armand Sabatier, for many years professor of zoology in that university. His success as a teacher and administrator was such, and the confidence he inspired so great, that he was able to command sufficient support, in the communities in which he labored, to build up a fine station.

In May, 1879, the first station at Cette was opened in the cottage of Marquès the fisherman, ever since attached to the institution. Harbor improvements and the growth of the enterprise necessitated several changes, and in 1884 the city of Cette placed three rooms in the École Victor Hugo at the disposal of the station, and in 1886 the station was attached to the École pratique des Hautes Études. These quarters were occupied until 1896, when part of the present roomy building became available. In the little laboratory in the École Victor Hugo, university classes and teachers met with enthusiasm on the weekly excursions to the seashore, and many French and foreign savants (Vogt, Fol, H. de Varigny, Roule, Koehler, and others) carried on their researches and brought their classes from other universities. The lack of sea-water circulation and the urgent need of more room led the director to institute in 1886-87 a series of public lectures in Montpellier and Cette, in which he set forth the educational, scientific, and practical value of biological stations.



A. AQUARIUM ROOM, MARSEILLES STATION.



B. GENERAL VIEW, ZOOLOGICAL STATION AT CETTE.

His efforts resulted in the formation at Cette of a local society to further the project, and in a subscription of 19,000 francs by friends of the movement. From the ministry of public works, through the minister, M. Yves Guyot, the station received 3,500 sq. m. of land on the shores of the Étang de Thau, at the entrance of the canal which connects this lagoon with the sea. The department of Herault in 1892 appropriated 10,000 francs, the city of Montpellier 50,000 francs in 1893, the city of Cette 75,000 francs in 1896, and the director of higher education 50,000 francs in 1897-98, a total of 185,000 francs, for the erection of the building which was commenced in 1892. Owing to the nature of the ground much time and money were consumed in securing adequate foundations, and it was not until 1896 that the station moved into its new and, then, but partially completed quarters. Upon the occasion of the twenty-fifth anniversary of the founding of the station, in May, 1904, the pupils and friends of the founder presented to the station a marble bust of Professor Sabatier by the sculptor Bassan, which now adorns the main hall of the building.

Upon the retirement in 1904 of Professor Sabatier, the directorship of the station was transferred to his successor at Montpellier, Prof. O. Duboscq, the present director.

The station at Cette is attached to the University of Montpellier, 28 km. distant, and is directly connected with its department of zoology, its entire staff being members of that department and receiving salaries directly from the university. The institution is, moreover, intimately associated with the instruction given in zoology, university classes in that subject meeting at the station weekly for a full day's session from March to July. The station also serves as research laboratories for the staff and advance students of the department.

The station is equipped for research and is open to all qualified investigators without charge on application to the director. A private room with the necessary glassware, reagents, etc., and animals for investigation, or the means of collecting them, are provided, and use of the excellent library and experimental aquaria is also granted. Microtomes are provided, but investigators should bring their own microscopes. The station has four furnished chambers the use of which is given to workers at the station for a nominal fee of 10 francs per month for service. Collecting for scientific and educational purposes is permitted and animals for research and instruction are supplied gratis to applicants elsewhere, the recipient bearing the expense of containers, reagents, and shipping. The station is open throughout the year with the préparateur and keeper in residence. Its rooms are most used in the Easter and summer vacations and upon Saturdays.

The station has no direct relation to the fisheries, but serves certain general interests by opening its aquarium to the public two days in the week. It also entertains excursions of students from the universities, normal, and secondary schools, and has from time to time conducted special classes for the pupils in the public schools of Cette.

The station at Cette has no general programme of research or exploration, each investigator working independently upon his own problems. The lines of investigation carried on have been mainly morphological or monographic upon marine invertebrates, especially bryozoa and annelids, and at present much of the research work is centered upon the marine Protozoa.

The results of the research have been published widely in many biological periodicals, some of which (works by Professor Sabatier) have been reissued under the title "Travaux de l'Institut de Zoologie de Montpellier et de la Station Zoologique de Cette, Première Série." A second series of independent memoirs bearing the same general title has been issued since 1885 and contains (1908) eighteen numbers.

The station receives but 3,500 francs per annum for its material upkeep. The entire staff is paid from the university budget and receives no special salary from station funds. The university also maintains the library and publications, and the equipment is intimately associated with that of the laboratory at Montpellier. The budget is made up from several sources, the university, the state, and the city of Cette each contributing 1,000 francs, and the department of Herault 500 francs per annum.

Cette is a provincial town, west of Marseille, near the middle of the shore of the Gulf of Lyon. It is the center of a large wine trade, and an important fishing port both for sea fisheries and shell-fish. It is reached by train in six hours from Marseille via Montpellier and lies on the route from Marseille to Banyuls-sur-Mer.

The station at Cette is located on l'Étang de Thau, a large coastal lagoon at the point where its main outlet, the Canal de la Bordigue traversing the city of Cette, leaves the lagoon for the sea. It is several minutes' walk from the railroad station, via the Pont Carnot and Quai de Bosc.

The building stands in grounds (42 by 60 m.) protected by a high iron fence. Its main axis runs north and south, parallel to the canal from which it is distant about 30 m. It stands at an elevation of 1.5 m. above high tide.

The station is a plain, well proportioned rectangular structure (14.32 by 41.38 m.) of masonry (Pl. XV, B) finished in stucco and dressed limestone with roof of red tile. It contains three floors above the basement and consists of two end sections (9 by 14.32 m.),

each full three stories in height and a central section (11 by 23 m.) of two stories and an attic.

The building is surrounded on all sides by a stone walk 1.2 m. wide projecting from the wall. It is entered at the south end by stairs ascending to the first floor 1.85 m. above ground level, affording abundant illumination for the basement, which is excavated throughout.

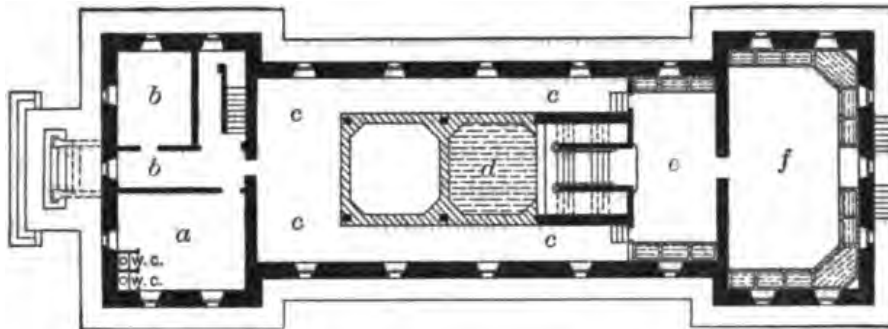


FIG. 4.—Basement floor, zoological station at Cette. From Calvet (1904).

The basement floor (fig. 4) is given over to the storeroom for fuel (*a*, 5.2 by 6 m.), the photographic dark room (*b*, 4.2 by 5.2 m.), a large room (*c*, 10 by 20.5 m.) containing the cooling basins for the aquarium circulation and numerous tables for small aquaria. The remainder of the basement contains the exhibition rooms of the public aquarium, a small hall with aquaria at the ends (*e*, 5 by 8 m.), and a larger one (*f*, 6 by 11.5 m.) with its corners obliquely cut off, surrounded on three sides by exhibition tanks.

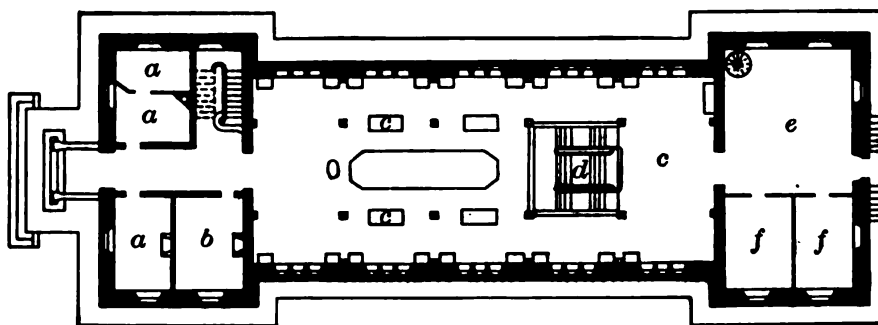


FIG. 5.—Ground floor, zoological station at Cette. From Calvet (1904).

The first story (fig. 5) of the building contains the living quarters (rooms *a*, *a*, *a*) of the keeper, the dining room (*b*, 4 by 5.5 m.) for the staff or for classes from the university. The main section of the building is given over entirely to the museum (*c*, 11 by 23 m.), containing an exhibition of the local fauna arranged in 24 well-lighted glass cases. In this hall stands the marble bust of the founder. On the walls near the entrance are lists of the benefactors whose gifts have contributed to the erection and equipment of the station.

The northern wing, originally a part of the museum, is now divided into a large general work room (*e*, 6 by 8 m.) and two research laboratories (*f*, *f*, each 3.2 by 5.2 m.). From the larger room a spiral iron stair ascends to the floors above.

The second story (fig. 6) contains the main working rooms of the station. The southern wing has the office (*a*) and private room (*b*) of the director and that (*c*) of the vice-director. Adjacent, are stairs to the floor above. At the end of the central corridor a door opens directly into the large well-lighted general laboratory (*d*, 10 by 10 m. with table space for 40 pupils. (Pl. XVI, A.) At one end of the room, above the door leading to the research laboratories, is the motto of the founder, "Partout est la vie." Upon either side upon the walls are paintings by artist friends of the station; upon the right, "The fishermen," by Leenhardt; upon the left a brilliant painting by Professor Balaman of a charming bit of the local coast in the evening sunlight.

From a central corridor leading to the large well-lighted library (*f*, 7 by 12.5 m.) open six research laboratories (*e*₁-*e*₆), each about

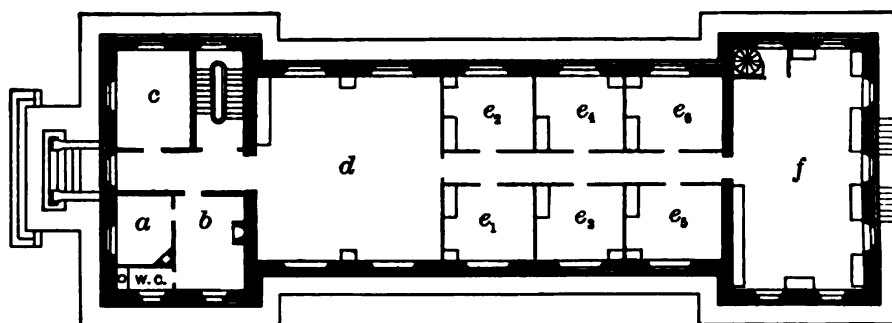


FIG. 6.—Upper floor, zoological station at Cette. From Calvet (1904)

4 by 5 m., abundantly lighted by a window 2 m. in width, are simply furnished with work tables facing the window, chest of drawers, shelving, sink with salt and fresh water supply, gas with hood. The rooms are heated by coal stoves. One of these laboratories at present used as a glassware room.

The third story contains four furnished chambers, the reserve for the laboratories on the floor below, and several large storerooms.

The small annex (6 by 14.25 m.) of one story, north of the main building, contains a well-lighted experimental aquarium room and dissecting room (5.5 by 6 m.), a shop (3 by 3 m.), and machine room (5.6 by 6 m.). The floor of the aquarium room is of cement and slopes to a central drain. The water tower with the reservoir supplying the aquaria and the windmill are adjacent to the annex.

The intimate association of the station at Cette with the laboratories at Montpellier insures adequate equipment of chemical reagents, glassware, and instruments for all lines of morphologic

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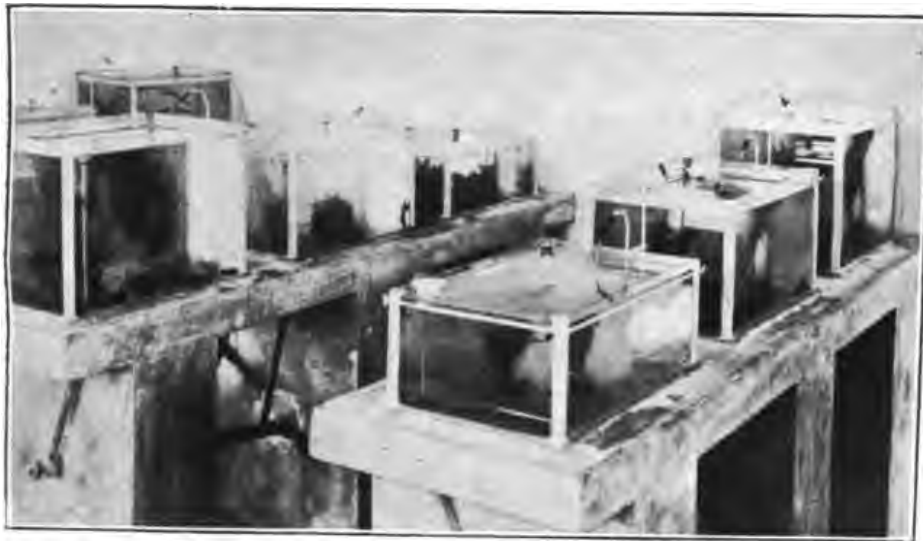


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A. INTERIOR OF GENERAL LABORATORY.



B. EXPERIMENTAL AQUARIA, FROM CALVET (1904).

ZOOLOGICAL STATION AT CETTE.



research and makes possible the prompt supply of any need in these particulars. Provision is made at Cette permanently of numerous student microscopes, two Minot rotary microtomes, paraffin ovens, water still, etc.

The library at Cette is exceptionally good and very fully catalogued. It contains nearly 5,000 volumes, including 123 serials (in 1905, see list in Calvet), and contains the libraries of its founder, Professor Sabatier, and of Doctor Rouzaud, and some gifts from the library of Quatrefrage. The serials include the *Challenger* Reports, the publications of the Naples station and the Institute at Monaco, a very complete representation of French serials, and a number of foreign purchases and exchanges. The library is splendidly organized and has complete author and subject card catalogues and also complete catalogues of the zoological library at the university and of the Academy of Sciences at Montpellier, whence books for use at the station can be secured in twenty-four hours or less.

The collections in the museum include a well-arranged and well-mounted exhibit in glazed cases of the local fauna and a large conchological collection, French and foreign, the gift of Abbé Culliéret. The collection of the local fauna was depleted by the fire at the exhibition in Montpellier in 1896 but has since been in part replenished. The exhibit is arranged systematically and is especially complete in annelids and bryozoans. There is also a small exhibit of oceanographical instruments and models.

The exhibition aquarium rooms in the basement are in grotto style, the light entering through the aquaria which are arranged around the periphery, immediately against the outer wall of the building, and receive the light through basement windows. Wooden doors above the glazed openings provide access to the aquaria for attendance, and the space below is also closed off in cupboards. There are in all eighteen tanks with bottom and partitions of 10 cm. reinforced concrete, resting on masonry walls. Of these tanks sixteen are of about 1 cu. m. capacity, while the two tanks in the corners with hexagonal bases contain 2.5 cu. m. The small tanks are 1.43 m. long, 0.9 m. wide and 0.8 m. high, with the base 0.87 m. above the floor. The two larger tanks have an opening 0.8 by 1.5 m. The plate glass fronts (22 cm. thick) are set in grooves in minium aquarium cement.

In the experimental aquarium room (5.1 by 6 m.) there are four reinforced concrete tables (0.6 by 2.5 m. and 1 m. high) with marginal channels for collection of accidental overflow from aquaria. Each table (Pl. XVI, B) carries three fixed aquaria built on the table with plate glass sides 5 mm. thick, held in place in brass angles (2 by 3 cm. and 2 mm. thick), set in the cement table top and held in place at

the top with adjustable brass rods. The top is 10 cm. thick, and rests on walls of the same material 15 cm. in thickness. The aquaria are each 38 cm. wide and 60 cm. long and of three heights, 23, 33, and 43 cm., respectively, on each table. Upon the floor of the room is a semicircular floor tank 3 m. in diameter and 0.5 deep and capacity of 3 cu. m., with concrete wall 30 cm. thick.

The aquaria throughout are supplied with overhead jet from a curved tin-lined copper pipe (6 mm.) and vertical standpipe with surface outflow. A perforated porcelain funnel (part of an incandescent gas fixture) is used for the top of the standpipe to prevent clogging of the outlet. The water is passed but once through the aquaria.

A large assortment of fishes and invertebrates is kept on exhibition in the tanks but the recent industrial development of petroleum refining works at Cette has added greatly to the difficulty of keeping animals alive in the aquarium. The discharge of wastes from the refineries into the Étang de Thau is proving disastrous both to the aquaria and to the fisheries of the region.

The pumping plant consists of an "Aeromotor" specially adapted to operate in the variable and often violent "mistral" which blows during October-May, and a 4-horsepower electric motor with a Thirion horizontal plunger pump of bronze with a capacity of 6,000 liters per hour. The water is drawn from a cistern 3 m. deep and 1.5 m. square, adjacent to the pump room. This cistern is connected with the canal by a cement conduit (0.4 to 0.5 m. in diameter) below the level of lowest water. The water passes through several copper screens before reaching the cistern. From the pump the water passes in subterranean mains to the water tower, to the cold basins in the basement, or to the high-level reservoir in the building. The water tower is a cylinder of reinforced concrete inclosed in an octagonal wooden building resting upon an octagonal masonry foundation 3.10 m. in height. The reservoir is 4.8 m. in diameter and 4 m. in height with walls 20 cm. thick and a capacity of 59 cu. m. The cold basins in the basement are two large reservoirs of 34 and 40 cu. m. capacity, respectively, originally intended as receivers of water from the adjacent canal to be pumped to the aquaria and laboratories. This project was, however, abandoned and the outside cistern and reservoir adopted. To avoid extremes of heat and cold in the water circulating in the aquaria it is carried from the cement reservoir in the water tower through a serpentine pipe immersed in the water of one of the protected reservoirs in the basement. By this means water from the Étang with temperature extremes of 0° and 28° can be delivered to the aquaria at 8° and 16°, respectively, in winter and summer. This system is, however, not used in the temperate seasons of the year.

A high-level reservoir of sheet iron lined with cement of 1 cu. m. capacity is placed on the third floor for supplying the laboratories. The mains are of 8 cm. (outside) cast-iron pipes, the smaller laterals and over-flow pipes of soft lead and the cocks and valves of brass.

The field equipment of the station consists of a small sailboat, an ample supply of dredges, and small collecting tackle. For hydrographical work the station has a Richard water bottle, Negretti and Zambra reversing thermometers, a Leger sounding cup, and a hand-sounding machine with 200 m. of sounding wire. The station is fortunate in having close at hand a number of fishermen's cottages, and in being able to arrange collecting trips with the numerous fishing boats that make Cette their home port. The fisheries patrol steamer *Girelle* (30 m. in length) also provides means for field excursions at sea.

The Étang de Thau is a shallow basin of 7.200 hectares, not exceeding 10 m. in depth. It has great expanses of very shallow water and bottom of sand or mud with large *Zostera* beds and oyster parks. The adjacent coast of the Mediterranean is mainly of a sandy character with bits of rocky shore where the Jurassic limestones are exposed. The adjacent waters of the Mediterranean are also shallow, the 50 m. and 100 m. lines being 12 and 36 kilometers distant, respectively. This extensive shallow area is the principal fishing ground on the south coast of France and affords a considerable variety of sandy, shelly, and some rocky bottom. The temperatures in the Étang range from 4° to 5° in January to 28° in August and the salinity is approximately that of the adjacent Mediterranean.

The local fauna is thus mainly that of sandy shores and bottom, and in the absence of the harder rocks the attached flora is relatively scanty. The bottom fauna is, however, abundant and varied, and especially rich in selachians, lamellibranchs, gasteropods, and annelids. A very full list is published in Calvet's excellent account of the station. The pelagic flora is described by Pavillard (1905).

Literature: Dean (1894), Gruvel (1898), Sand (1897), Calvet (1905).

LABORATORY ARAGO, OF THE FACULTY OF SCIENCES OF THE UNIVERSITY OF PARIS, BANYULS-SUR-MER (PYRÉNÉES-ORIENTALES), FRANCE.

Director, Prof. G. Pruvot, Laboratoire de Zoologie, La Sorbonne, Paris. (At Banyuls-sur-Mer, September to March.)

Assistant director, Dr. E.-G. Racovitza, Laboratoire de Zoologie, La Sorbonne, Paris. (At Banyuls-sur-Mer, March to August.)

Commercy research fellow, Dr. R. Jeannel, Banyuls-sur-Mer.

Assistant to the marine fisheries service, Dr. L. Fage, Banyuls-sur-Mer.

Captain of the *Roland* and mechanician, Mr. Theodore David.

In addition, one keeper and engineer, one pilot and net maker, one fisherman, and one laboratory servant.

Telegraph address: Laboratoire, Banyuls-sur-Mer.

The founder of the station at Roscoff, Prof. Henri de Lacaze-Duthiers, was also the founder of that at Banyuls and was its director till his death in 1900. The winter storms which sweep the northern coasts of France and render marine work perilous and collecting at times impossible, led the director of the Roscoff station to plan a sister station on the southern shores of France, where in winter months work interrupted in the northern laboratory might be carried on under advantageous conditions of climate and amid pleasant surroundings and where the rich fauna of southern waters might be made available for French investigators. Foiled in his efforts to secure a choice location in the harbor of Port-Vendres, because of its possible utility for military purposes in the event of war, Prof. Lacaze-Duthiers turned to Banyuls-sur-Mer, a neighboring fishing village near the Spanish frontier, where local interest in the project was so great that a sum of 25,000 francs was offered, together with a sail boat and a fine location for the building near the mouth of the little bay. The advantages possessed by this location, in addition to the natural conditions of the environment, were the existence of a small fishing fleet and the absence of commercial and industrial enterprises which might endanger the purity of the water.

The laboratory was built in 1881 and bears the name "Laboratoire Arago" in honor of the astronomer-physicist, Dom. F. J. Arago, who was a native of Perpignan, the capital of the Department of the Pyrénées-Orientales. It owes its origin entirely to the enterprise of its first director, who, without aid from the state and in the face of much opposition, carried through the enterprise to a successful issue. The funds came in part from the village of Banyuls-sur-Mer and in part from the Department of the Pyrénées-Orientales.

In 1883 the property was formally transferred by the village of Banyuls-sur-Mer to the École des Hautes Études of the University of Paris, which then made provision for its running expenses. In 1883 the east and west ends of the building were added for the machine room and quarters of the keeper, the interior of the original structure improved, and a windmill and reservoir on the hill above the station added to the equipment, at an expense of 29,000 francs contributed by the provincial council, the municipal councils of Toulouse and Perpignan, and by friends. In 1884 the third floor of the building, containing the living quarters for the workers at the station, was completed and furnished. In 1887 a steam engine and rotary pump were installed to replace the very unsatisfactory windmill. In 1890-91 the ministries of public instruction and of agriculture and the general council of the province contributed the funds necessary for the construction of a large vivier or basin surrounded with walls of masonry for the purpose of culture of marine animals and for a shelter harbor for the flotilla of boats.

In 1893 a new epoch in the life of the station was opened with the gift by Prince Roland Bonaparte of 50,000 francs for a steamship for the station. This ship, the *Roland*, was an iron vessel of 22 tons, and at once vastly increased the facilities for marine exploration and for supplying the laboratories with material for research. The ship added, however, greatly to the expense of equipping and maintaining the station. It necessitated the construction of a dock, excavated in the rock within the vivier, for cleaning and painting the hull, which the warm and saline waters of the Mediterranean corroded with great rapidity. The remoteness of Banyuls-sur-Mer from any great commercial center greatly complicated the question of repairs, a difficulty only solved by the extension of the building and equipment of a machine shop where all necessary repairs could be made.

The station was exceptionally fortunate in securing for its mechanic M. Th. David, a machinist of the first rank in the French naval service. He brought to the station not only great mechanical skill and experience, but a live interest in the problems to be solved, a zeal indefatigable, and an inventive ability little short of genius. The growing laboratory at Banyuls abounds in many details of equipment which attest his high success. It is exceptional among the laboratories of Europe in the extent to which the equipment is constructed in its own shops.

In this same year a photographic atelier perched on the rocks to the rear of the station above a new reservoir of sea water was added to the equipment. The total expense of these improvements, including the *Roland*, was 85,000 francs, and was met in this instance also by the gifts of private donors.

In 1895 the laboratory was enlarged by excavation of the hill to the rear and the erection of a large room of one story with overhead light for the experimental work, and by the extension of the quarters for the machine shop. The equipment was increased by the construction of a sounding machine with 2-horsepower engine, and in 1896 the entire hydraulic system was overhauled and renewed.

The *Roland*, built in 1893, was so corroded by the destructive action of the sea water, in spite of constant care, that it became necessary to replace the ship with another. Accordingly, in 1900, a wooden vessel, also christened the *Roland*, was built on the beach near the laboratory by M. David and equipped with the machinery of its predecessor.

Associated with Professor Lacaze-Duthiers, in the years of growth of the station, as his assistants were Professors Joubin, Prouho, Guitel, and Robert. In 1897 Prof. G. Pruvot, then of the University of Grenoble, was appointed assistant director (sous-directeur) and, upon the death of the director in 1900, was appointed as his successor, and Dr. E.-G. Racovitza succeeded to the post of assistant director (sous-directeur et chef des travaux pratiques).

The station at Banyuls-sur-Mer is an appanage of the faculty of sciences, University of Paris. It is not attached to any university chair, but holds the same relation to the higher authorities which the zoological laboratory of the Sorbonne holds. It is thus autonomous, under the superior authority only of the faculty of sciences, the dean of the faculty, and the minister of public instruction. The director is appointed, after the manner of professors in the university, by the minister, from two nominations made to him by the faculty of sciences, and two others, which may or may not be identical with those of the faculty, made by the council of the faculty. The director is responsible only to the faculty, the dean, and the minister, and makes to them an annual report on the affairs of the station.

The station receives an annual subvention from the ministry of public instruction, in the budget of the faculty of sciences, of 8,000 francs, disbursed at Paris by the treasury on approved accounts. In addition to this subvention, the salaries of the staff, including that of the mechanic and the keeper, are paid from the government budget. There is also an annual subvention of 3,500 francs for fisheries investigations from the ministry of the marine, the station furnishing in return for this sum the use of a research room and placing its facilities for marine research at the disposal of a member of the fisheries staff, the present incumbent of the position being Dr. L. Fage, an assistant in the "Service des pêches maritimes." This association is the only relation which the Banyuls station bears officially to the fisheries.

The Commercy legacy to the University of Paris of 4,000,000 francs provides, among other research fellowships, one of 5,000 francs which is assigned to an investigator who must be resident at the Arago laboratory and render the service of a scientific assistant to the institution. The appointment is made for one year, but may be renewed for two additional years. The present appointee is Dr. R. Jeannel.

Excluding the salaries of the staff as above noted, which are otherwise provided for, the total annual expense of maintaining the Arago laboratory is about 20,000 francs. Of this, 8,000 comes from the budget of the faculty of sciences, 3,500 from the ministry of the marine, 2,000 to 3,000 of the deficit is met each year by the university, and the remaining 6,500 to 7,500 is paid by the director and assistant director and friends of the institution. The expenses are approximately distributed as follows:

	Francs.
Labor.....	6,000
Library (subscriptions and binding).....	1,200
Upkeep of "Roland" and machine shop.....	8,000
Glassware, reagents, supplies, and miscell.....	4,800
Total.....	20,000

The laboratory has no endowment and receives no income from rent of tables or sale of collections.

The aim and purpose of the Banyuls station is primarily that of pure research. No instruction or regular courses are given to students of university grade. The laboratories are not reserved for the students or investigators of any university, but are open to everyone upon the same terms. Students from the Sorbonne frequently come here for their doctorate investigations, but attendance is not obligatory. A remarkable atmosphere of freedom pervades the institution. There are no fees, no rules and regulations, and no restrictions of any sort upon investigators enjoying the hospitality of the station.

Applications for admission should be sent in advance to "The Director," Laboratoire Arago, Banyuls-sur-Mer. Travelers to the station receive permits for half-fare privileges on the railways in France, but application for permits should be filed at least ten days in advance with the authorities of the station at Banyuls. Investigators have the use of a private research room, the supply of living material for research, the use of glassware and chemicals, paraffin oven, and microtome, and also of microscope if desired, but if convenient it is preferred that workers provide their own microscopes or objectives, especially in the case of high-grade instruments. The use of aquaria in the observation room and the privilege of collecting with the marine equipment is also accorded freely. Collecting not only for research but also for university laboratories and public museums is permitted after the research laboratories and the aquaria are supplied. Only commercial collecting is forbidden.

The investigator is free to work as he wishes and to publish his results where he will. The station staff assumes no responsibility for his work. A cordial welcome, however, awaits the worker and friendly advice is freely given.

The laboratory at Banyuls has comfortable accommodations for 12 investigators, but 20 can be provided with working tables at one time, if need be. The number of investigators varies from 20 to 40 per year, the average being about 30. The autumn and spring are the most popular seasons.

The laboratory is open throughout the whole year, but with reduced service and no field work in August. The third floor of the main building contains ten rooms which are comfortably but simply furnished as bedrooms. They are used by guests of the station without charge, save a payment of 10 francs per month to the servant. Arrangements may also be made with the keeper for simple meals or morning "café au lait," and an adjacent hotel or cafés in the town, a few minutes' walk from the station, also afford comfortable

though not elegant accommodations. The best months of the year are September–December and April–July. The summer is apt to be hot, and in winter the cold “mistral” from the mountains sometimes brings chill and discomfort, as well as effectively preventing work at sea.

Banyuls is a quaint fishing village of 3,400 inhabitants, at a considerable distance from any city of importance. It is a summer resort, frequented by excursions from the interior and visited also for its baths. The back country and the adjacent coasts of Spain, with fine mountain scenery and picturesque glimpses of provincial life, afford an attractive field for excursions.

The founder of the Banyuls station had from the first the desire to make the institution one of general service, and planned to use its facilities for the cultivation of popular interest in and knowledge of the life of the sea. To this end an attractive hall, adorned with statuary and surrounded with aquaria, is freely open to the public on five days in the week. Admission has always been free, and by the side of each aquarium is a large blackboard upon which explanatory labels and drawings are placed for the general information of the public. The hall is also provided with seats, and the station possesses a stereopticon which may be used for lectures. The aquarium is often visited during the summer by 600 to 1,000 persons in a single day. In the week of the anniversary (May 10) of the death of the founder of the station the school children of Banyuls assemble at the station for a lecture on the purpose of the station and the life of the founder, with illustrations from the field of marine biology. The men and later the women students of the normal schools in Perpignan make an annual excursion to the station for lectures and demonstrations. Local organizations, societies, Alpine clubs, etc., are also entertained from time to time by popular talks. The directors also give two illustrated evening lectures each year on some biological topic in the neighboring city of Perpignan. Beginning with 1909 the public-school teachers of three provinces are to be received a few days each year for popular instruction regarding the life of the sea. The station is also visited frequently by classes of students from the universities of Toulouse, Montpellier, and Barcelona. Although subject to these invasions of popular and semiscientific excursions, the Banyuls laboratory is so constructed that the work of the investigators need not be disturbed thereby. The research rooms and the aquaria used in investigation are not open to the public.

In the Easter vacation, under the auspices of the directors of the station, an annual excursion from Paris is conducted each year to Banyuls. The itinerary is varied, including about a week at the station, with excursions to sea, collecting trips along shore, lectures and demonstrations in the aquarium hall, and field trips to Corsica,

the Balearic Islands, into Spain, or the Pyrenees. Colleagues from various universities join in the expeditions, which are always conducted by professors in zoology, botany, and geology. These excursions are so planned as to be completed within three weeks and not to exceed 200 francs in cost. Though primarily scientific in purpose and scope, they are open to all properly qualified persons on application. These excursions have been quite popular and membership in them is much sought, 40 to 100 persons sharing in them each year. The excursions are open to foreigners also.

There is one field of activity of the station which though not biological and only remotely affecting the proper work of the station nevertheless strikingly illustrates the spirit of public service which dominates its administration, and therefore merits notice here. Under the guidance of M. David, the expert mechanician of the station, 10 boys from the neighborhood are received annually in the shops for practical instruction in shop practice, and incidentally in methods of marine exploration, supplementing instruction in the public schools with a view to preparation for the competitive examinations for admission to the French school for naval machinists at Lorient. The boys from M. David's hands have an enviable record in this school.

One of the important functions of the Banyuls station is the sending of living animals by parcels post to schools, universities, and investigators. No charge is made for this service beyond the outlay for the packing and shipment, which amount to 4.10 francs per package. Living animals of many sorts are sent safely in this fashion to Paris, and in winter even to Belgium. Many hundreds of shipments are thus made of material for use in laboratory courses in the higher institutions of learning in France and other countries, for the service is not restricted by national boundaries.

The Arago laboratory has had no elaborate plan of investigation. Its directors have always been associated with universities and engaged in instruction, so that a continuous or regular plan of exploration or investigation has been impossible. Many important morphological, embryological, and systematic investigations upon the marine fauna have been made in its laboratories, and the results of its explorations of the Gulf of Lyon between Cette and Barcelona are accumulated in an orderly manner, looking toward their coordination in a systematic account of the oceanography and marine zoology of this region. Several preliminary papers on the subject have already been published in the "Archives de Zoologie expérimentale et générale."

Banyuls-sur-Mer is located about 6 kilometers from the Spanish frontier on a diminutive roadstead of the same name which is open to the northeast. It is reached by rail from Paris in fifteen hours via

Narbonne, or in about five hours from Cette. The Marseille-Algiers steamers call at Port Vendres, 5 kilometers up the coast. The station is located on the southern shore of the roadstead near its entrance, about ten minutes' walk from the local railway station.

The grounds (Pl. XVII), which contain 10,852 sq. m., are of irregular form on the steep, rocky hillside, which has been excavated to make room for the main building and some of its adjuncts. Located on the grounds are the main building of the station (Pl. XVIII, *A*), with the adjoining building containing quarters for the keeper (Pl. XVII, *H*) and the residence of the director (*c, d, e, f, h*), and also some additional rooms of the station. There are also on the grounds the photographic atelier (*T, U*), the acetylene house (*P*), the greenhouse (*Q*), aviary (*R*), laundry (*O*), and a small cottage, and projecting into the harbor two moles, one of which forms one side of the vivier or safety harbor, in which is located the dry dock for the ship.

At the edge of the cliff overlooking the sea is the tomb of the founder, soon to be marked by a fine bronze statue by the sculptor, Beulliure.

The main building (Pl. XVIII, *A*) is a perfectly plain barracks-like structure of three stories of rectangular form (10 by 29 m.), with its adjuncts covering 1,145 sq. m., built of the local metamorphosed schists quarried on the spot. Its long axis is parallel with the water front and runs east-northeast by south-southwest. It faces the harbor, standing at a distance of 9 m. from the sea wall and 4 to 5 m. above sea level.

On the ground floor is a large aquarium room (*A*, 10 by 23 m.), the office (*E*, 4 by 6 m.), and small museum or collection room (*F*, 4 by 4 m.). The one-story extension to the northeast contains the machine shop (*D*, 8 by 10 m.). To the rear of the machine shop are several one-story buildings with skylights containing the smithy (*C*, 3 by 12 m.) and oil tanks (*c'*), the carpenter and repair shop (*B*, 8 by 12 m.), and the experimental aquarium room (*A'*, 7 by 12 m.). At the other end the main building is continued at a lower level in a slightly narrower extension of three stories (9 by 27 m.), which has on its ground floor the vestibule (*G*), keeper's quarters (*H*) of three rooms, glass room (*I*, 3 by 6 m.), storeroom (*J*, 4 by 6 m.), and a large room (*K*, 6 by 7 m.) for nets, tackle, cordage, and sails, two small laboratories (*L, L'*, 2.5 by 12 m.), and a bathroom (*M*, 2.5 by 4 m.).

The third floor of this part of the building is at the same level as the second floor of the main building. This floor contains, as shown (Pl. XVII, second floor), a long, central corridor, opening from which are seven investigators' laboratories (*a*, 4 by 4 m.), the office and laboratory (*a*, 4 by 8 m.) of the assistant director, the large library rooms (*b, b*, 4 by 16 m.), and the reagent room (*j*, 3 by 4 m.). From the corridor, stairs ascend to the fourteen chambers on the third floor



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of the main building, and lead directly into the collection and preparation room (*k*, 4 by 12 m.), from which open the dark room (*n*, 2.7 by 3 m.) and the laboratories of the director (*l*, *m*, 3.5 by 7 and 2 by 3 m.) and Madame Pruvot (née Fol) (*i*, 4 by 4 m.). The remainder of this floor (*c*, *d*, *e*, *f*, *g*, *h*) is occupied by the office and residence of the director. Iron bridges lead from this floor to the garden on the hill at the rear, where is located the photographic studio, and above the shops to the terrace at the sea cliff.

The aquarium room (Pl. XVIII, *B*) of the Banyuls station is used also as a small assembly hall.

About the hall is a row of busts—Æsculapius, Descartes, Lavoisier, A. L. and B. Jussieu, Linné, Laperouse, Forbin, Pascal, Ducouédie, Duhamel, Buffon, Réaumur, and Daubenton—the gift of the Academy of Fine Arts, and at the far end of the hall is a cast of the Venus of Milo. On the frieze above the busts is the motto “La Science n’a ni Religion ni Politique,” the motto of the founder. A replica in plaster of the bronze bust of Professor Lacaze-Duthiers, given to the faculty of sciences at Paris by the faculty of the University of Barcelona, stands upon the lecture desk.

The windows are draped with heavy curtains to give the desired grotto effect to the room. An arc lamp with powerful reflector, used for the illumination of the aquaria for evening demonstrations, is provided in the lecture hall.

There is a bank of seven wall tanks along the end and the east wall, with three additional ones in the passage at the rear. These tanks are set in arches of the masonry wall and rest on masonry foundations. They are built of brick faced with cement, and their dimensions (external) are 2 m. long, 0.7 m. high, and 0.7 m. wide, with walls 10–15 cm. in thickness. The rear walls of those aquaria designed for sessile animals are sloped upward at an angle of about 40°, and most of the walls are faced with natural rock. The glazed openings measure 62 by 180 cm., and the glass is 23 mm. thick, set in minium cement in grooves in the masonry with bedding and backing of tow between the masonry on one hand and the cement or glass on the other. The bottom of the aquarium is 1 m. from the floor, and the glass is set back 22 cm. from the face of the masonry. Many panes set in 1882 are still undisturbed. Settling of the walls causes breakage in places. The aquaria are accessible both from front and rear for attendance, a sloping wooden door giving access from the front.

In the passage at the rear a larger tank (1.65 long, 1.15 wide, and 0.9 high, with glass 0.65 by 1.30 m.) projects from the building into the open air. It is sheltered above by a sloping roof of ribbed glass with free access of the air beneath. This aquarium is subject to greater changes of temperature, to access of dust, to more overhead

light, and is less satisfactory than the other aquaria, suffering from an excess of growth of green algæ, from unusual outbreaks of *Sarole* and is exposed to extremes of temperature which are deleterious to the animals within, and is therefore instructive as to the relation of these conditions to the maintenance of aquaria.

An aquarium (a gift to the station some years ago), on the inner wall of the passage, measures 1.60 by 0.70 by 0.95, and one at the end of the passage, the largest in the building, is 4 m. long, 2 m. wide, and 1 m. deep. Its walls are of sheet iron lined with cement (2 cm.), and the rust from the iron works through the cement in places. The aquaria are lighted from skylights in the research aquaria room.

Arranged along the west side of the aquarium hall is a row of several open rectangular aquaria on black marble tables with glass sides (Pl. XVIII, B, and Pl. XX, A.) The top of the tables is 0.9 m. from the floor, and the aquaria are all approximately 55 by 80 cm. The height varies, being 13, 18, 25, and 48 cm. The marble table forms the bottom of the aquaria, and the corners are of angle brass (3 by 3 cm. and 2 mm. thick or 4 by 4 and 3 mm. thick) held from spreading in the case of the two higher types by an adjustable brass band. The glass is 8 mm. in thickness, save in the largest aquaria, where it is 21. The marble, originally polished, has corroded badly under the action of the sea water. In the center of the room is a cement-floor basin, which receives the discharge from the exhibition tanks. It is elliptical in form (3 by 4 m.), with walls 25 cm. thick and 35 cm. high, and a central fountain.

The aquaria in the adjacent experimental room (Pl. XIX, fig. 2) are of a different construction. There are eleven iron tables 67 by 112 cm. with tops of molded glass standing 88 cm. from the floor. The glass is cast so that the sides of the aquaria can be set in grooves in the top, which is perforated by holes for the inlet and outlet. The aquaria all measure 36 by 82 cm. and have plate-glass sides of 11, 15, 20, or 25 cm. in height held in brass angles at the corners and having top clamps of brass across the ends.

Two aquarium tables (Pl. XIX, A) of white tile with tops 0.64 by 4 m. and a tile facing on the wall at the rear 64 cm. high and a cement channel at the rear to carry off the waste serve also for movable aquaria of glass. An overhead pipe line with numerous taps supplies the water.

The single-circuit system of circulation is used at Banyuls. The water is pumped by a 9-horsepower petrol motor (system Merlin-Vierzon), which also serves for power for the machine shop. It is connected with a centrifugal pump of phosphor-bronze (type Dumont) with a capacity of 30 cu. m. per hour. The water is drawn through an 8 cm. red-copper sea pipe 30 m. in length carried to the outer side of the promontory and terminating in a masonry basin 1.3 below the

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A. GENERAL VIEW FROM THE HILL ABOVE.

From photograph by Doctor Racovitz.



B. INTERIOR OF EXHIBITION ROOM.

From photograph by Doctor Racovitz.

LABORATOIRE ARAGO, BANYULS-SUR-MER.



A. TILE-COVERED AQUARIUM BENCH.



B. EXPERIMENTAL AQUARIA AND WATER FILTER.

EXPERIMENTAL AQUARIUM ROOM AT BANYULS.



surface at the water's edge. To avoid copper salts the first water passed through the pump is not admitted to the reservoir. From the pump the water passes through a 10 cm. main of cast iron to the reservoirs, which have a capacity of 180 and 100 cu. m., respectively. The pump is 6 m. above sea level and the reservoirs 12 and 15.75 m., respectively. The reservoirs are excavated in the solid rock and lined with cement, and are covered with earth to keep the water at a low temperature. The reservoirs are at an elevation of 5 and 9 m., respectively, above the outlets to the aquaria. The daily consumption of water is 40-45 cu. m. in summer and 30 in the colder season.

The circulating system consists of 6 cm. cast-iron pipe made in short lengths of 1 to 2 m. with flush ends, india-rubber gaskets and screw clamps binding together the flanges. Any unit in the system can be removed without disturbing others. The laterals are of 2 cm. soft lead pipe, with terminal cocks of hard rubber. The valves in the mains are of cast iron.

The aquaria are all fed by overhead sprays discharged from a glass pipette at an elevation of a few inches above the surface of the aquarium. No other aerating apparatus is used. The outlets are lead pipes 3 cm. in diameter let into the walls of the masonry tanks for a surface discharge. In the small glass aquaria there are stand-pipes with surface overflow guarded by a flaring perforated funnel of porcelain. The table aquaria in the exhibition room (Pl. XX, A) are fed through curved brass pipes (1.5 cm. diameter) and have vertical standards for discharge. While algæ do not grow in these tanks, delicate animals, such as *Cerianthus*, gorgonians, and pennatulids, thrive, and sponges develop naturally, indicating no marked deleterious effect resulting from the brief exposure of the water to the metal. The waste water from the aquarium hall passes to a concealed tank beneath the entrance steps which is used as an acclimatization basin for animals destined for the aquaria or for shipment.

The aquarium cement used at Banyuls is the customary minium cement and a new "Mastic de Cette," a water and spirit proof odorless cement which retains pliability at low temperature and is reported to be both durable and very effective. It is used extensively in the wine trade for wooden wine vats and possesses the qualities of adhesiveness, impermeability, and elasticity desirable in an aquarium cement.

The aquaria at Banyuls are justly famous for their thriving condition and the perfection with which many forms of animal life grow and reproduce therein. In the aquaria one sees not only the usual array of tunicates, anemones, crabs, lobsters, fishes, mollusks, and starfish, but the delicate and beautiful *Spirographis*, *Cerianthus*, *Veretillum*, pennatulids, gorgonians, *Alcyonium*, and corals such as *Caryophyllum*, *Flabellum*, and *Balanophyllia*, the zoantharian (*Poly-*

thoa) associated with the sponge (*Azinella*), the rare *Bonellia* and other sessile worms of various kinds which are attached to the walls and even the glass of the aquaria. Calcareous seaweeds thrive in the aquaria, and green seaweeds coat the walls and bottoms of the better-lighted tanks.

The purity of the original supply, the carefully regulated temperature in the reservoirs, the single-circuit system of circulation, and the absence, save for the exceptions above noted, of deleterious metals are factors favoring this condition. The iron pipes, especially in dead ends or when water stands in them for some time, accumulate some rust, and this mechanically interferes with the respiration of some animals, as for example the crustaceans, and is also troublesome in culture aquaria for larvæ or pure cultures of algæ, but it seems to have no other deleterious effect upon the life in the aquaria.

The equipment of the research rooms at Banyuls is simple. It includes a U-shaped table in the center of the room 60 and 70 cm. wide and 3.2 m. (inside) long, with small water tank and sink, blackboard, cupboard, and book-shelves and chest of drawers. The rooms are supplied with gas, fresh water, and electric light and are heated by grates or stoves.

The laboratory has a very generous supply of chemicals, reagents, glassware, and the many small items of desk equipment for laboratory work. It possesses twenty microscopes of Nacet and Verick patterns, three with immersion lenses, an ample supply of dissecting lenses and drawing apparatus, five microtomes (two Minot rotary, one Jung sliding, and two of the Dumeige rocking pattern). There are two dark rooms fully equipped for photographic work, one of them located in the atelier above the upper reservoir. This atelier is equipped with an ample laboratory for biological work adjacent to the photographic room, which contains a huge Zeiss micro-photographic apparatus and an equipment of Zeiss protar and planar lenses for the photography of living animals. A unique feature of the equipment is an apparatus whereby animals in polished glass jars lowered into the darkness and even temperature of the reservoir below until they are completely expanded can be brought easily within reach of the camera by means of an elevator.

The resources of the station are also extended by a small animal house, an aviary, and a small greenhouse where experiments with the interesting local land fauna may be conducted if desired. Banyuls lies just within the region of the most northerly extension into Europe of the African land fauna and possesses accordingly a number of forms of unusual interest and rarity for European naturalists.

The collections made in the course of the explorations of the *Roland* remain at Banyuls, affording an abundant stock for examina-

tion or research. A selection of named forms illustrating the local fauna is permanently mounted and placed on exhibition in glazed cases.

The library at Banyuls is second only to that at Naples and Helgoland in its size and completeness. It contains over 5,000 volumes, including about 75 of the leading biological journals and periodicals, bibliographies and reviews of zoological literature, the principal reports of marine explorations, and the leading monographic works and general treatises. There is also a large library of reprints and a small library of selected general literature for idle hours. The library has a card catalogue, is freely accessible, and is pleasantly furnished. It contains the personal library of its founder and of Professor Pruvot and Doctor Racovitza, the present editors and proprietors of the "Archives de Zoologie expérimentale." A list of the more important serials, etc., in the library will be found in the "Archives" for 1901, and of the monographs and individual treatises in subsequent volumes.

The marine equipment of the Banyuls station is exceptionally complete and is maintained in a very high state of efficiency. In addition to a flotilla of five small boats, a small sail boat, and a 6 m. motor boat, there is a wooden steamer, the *Roland* (Pl. XX, B), the most completely equipped small steamer for biological work to be found among the stations of Europe. The *Roland* is 22.22 m. long, 4.65 m. wide, and has a draft of 2.1 m. aft. She is a stout wooden steamer of 118 tons gross, with a single mast forward and a full equipment of sails, deck houses forward and aft, and deck space forward and astern for landing of trawls, etc. The wheel is upon the forward deck house (which contains the galley) in a commanding position for maneuvering the boat and tackle. On a table amidships, in front of the after cabin, is the sounding machine, with its one-half horsepower engine. She has a 75-horsepower compound condensing engine, with distilling apparatus for boiler water, a 3-horsepower dynamo for electric light for lighting the ship and for pelagic towing at night, a 9-horsepower pump which provides also for a circulating system in storage tanks for collections on deck. The bunkers can receive 12 tons of coal, sufficient for eighty hours' continuous steaming at 7 knots per hour.

There is a steam winch of 10 horsepower forward, with supplementary hand winch for reeling up the cable or for light work. In summer 1,000 m. of 12 mm. galvanized steel cable is carried on the reel. In winter only 500 m. is used. For heavy work or in heavy weather the cable is passed aft between rollers, while in quiet weather or for light work the tackle is handled forward.

The sounding machine, made in the shops of the laboratory, carries 2,000 m. of 0.7 mm. steel piano wire. The drum also carries

800 or 1,500 m. of 4 mm. galvanized steel cable for plankton and hydrographic work. The boat is equipped with the usual dredges, nets, and seines, with otter trawl and beam trawl, coral tangles, and a number of large plankton nets of several types for pelagic fishing. The hydrographic equipment includes two reversing thermometers, bottom samplers of various types, and two water bottles (Richard).

The rear cabin (3 by 3 m.) serves as a laboratory and is provided with folding tables at the windows, a center table, and convenient reagent lockers, shelving, and racks. The boat is remarkable for the completeness with which all available space is utilized and for the compactness of her fittings. She has ample lockers for glassware, reagents, and collections, the space along the gunwales being utilized for a bank of thin cupboards for glassware, etc., and a conveniently located reagent case is placed on the rear face of the cabin near the sorting deck. Racks for collecting jars are arranged along the port side. Refrigerator, dark room, and tackle room are placed below deck. Berths for fifteen persons are provided, six forward in the forecabin, two for engineer and captain aft of the engine room, two small separate cabins below, each for two persons, and three folding berths aft on deck.

The station also has a scaphander with pump and hose for explorations to a depth of 40 m. It has proved to be an important adjunct of the station in exploring the coasts, and especially the grottoes, which are numerous along the limestone cliffs of the region.

The machine shop of the Banyuls station is the best equipped one found in connection with any European station. It is fitted for metal, wood, and electrical work and contains a forge and small foundry and a considerable assortment of machine tools, such as power lathes, shaper, planer, drills, dynamo of 40 amperes, and accumulator. M. David and his apprentices do in this shop practically all of the construction work in connection with the station and its boat, building everything from museum cases to sounding machines.

The two papers of Pruvot (1894, 1895) give a very adequate account of the local oceanographic conditions and of the distribution of the local fauna. The shores in the region are predominantly rocky, of schists and limestones, with a few sandy beaches. The shore line is everywhere marked by a "trottoir" or platform of calcareous algae. The shore falls away rather abruptly to depths of 30 to 50 m., but thence a great plateau of mud and sand, 50 to 110 m., slopes seaward for a distance of 25 to 39 km. before sinking abruptly into several sunken valleys whose sides descend suddenly to a depth of 800 m. There is a narrow *Laminaria* and a wide *Lithothamnion* zone, and scattered rocky "banks" are interspersed in the plateau.



The flora and fauna are much like those at Marseille, Villefranche, Monaco, and Naples. The pelagic fauna is rich, especially in the deeper waters or after a spell of "mistral" weather. The shore and bottom life is rich and varied. The lists published by Pruvot of common species include many choice treasures for the naturalist, *Cerianthus*, *Bonellia*, *Polygordius*, *Antedon* (1,500 in one haul of the dredge), *Amphioxus*, *Corallium*, *Sepia*, *Brissopsis*, *Neomenia*, corals, and brachiopods in the deeper waters. A large territory has been explored and mapped adjacent to Banyuls and its fauna fully recorded. In general, temperatures and salinities are similar to those at Monaco, and as elsewhere in the Mediterranean the tides are insignificant—0.4 to 0.6 m.

Literature: Lacaze-Duthiers (1874, 1877, 1881, 1881a, 1891, 1895, 1898), Dean (1894), Francotte (1907), Gruvel (1898), Sand (1897), Pruvot (1894, 1895, 1897, 1901), Houssay (1893).

**BIOLOGICAL STATION OF ARCACHON, ARCACHON (GIRONDE),
FRANCE.**

Director, Prof. Felix Jolyet, professor of physiology, École de Médecine, Université, Bordeaux.

Assistant director, Dr. J. Sellier, Chef des Travaux, Laboratoire de Physiologie, École de Médecine, Université, Bordeaux.

Preparator, M. Delaunay.

In addition a keeper and one machinist and fisherman.

Telegraph address: Aquarium, Arcachon.

The laboratory at Arcachon enjoys the distinction of being one of the oldest in Europe and one of the first to open its doors gratuitously to the scientific world for the purposes of research. It is all the more remarkable in its origin and history, since it originated as the private enterprise of a local scientific society, Société Scientifique d'Arcachon, in 1863, having for its avowed objects the aiding of the study, the advancement and popularization of the natural sciences, and the development of aquiculture. To this end it set about to organize and maintain a museum, library, and an aquarium with laboratories for study and research in biological science.

Prof. Paul Bert, the noted physiologist, and the conchologist, Professor Fischer, were active in aid and counsel to the infant enterprise. In 1866 the society undertook the somewhat ambitious task of conducting an International Exposition of Fisheries and Aquiculture at Arcachon and achieved a considerable success with 588 exhibits in the building erected for the purpose. The exposition building and the aquarium became the permanent plant of the station and are still in use, while the exhibits furnished the beginning of the museum and library. The enterprise left the society, however, heavily burdened with a debt of 45,000 francs, loaned by members

and friends of the enterprise, under which it labored till 1896, when, by agreement, it was largely reduced by cancellation and the payment of the balance arranged for in yearly allotments, terminating in 1906.

In the meantime the society voted, in 1867, to proceed with the construction of a special laboratory building, but the war of 1870 and its consequences embarrassed the enterprise for twelve years, so that the laboratory was not actually begun until 1883. The establishment of a faculty of medicine and pharmacy at Bordeaux created the demand for a marine laboratory for the use of its professors and students which had exceeded the then meager facilities at Arcachon. The society, still adhering with great pertinacity to its autonomy and independence and final control of the station, placed its resources at the disposition of the university and endeavored to increase its facilities by the erection of the special laboratory building. A lottery designed to provide the funds yielded only 7,359 francs, a sum with supplementary aid from the society sufficient to erect only four rooms of the projected building. It was not until 1902 that the building with eight private laboratories and five chambers was completed.

The enterprise at Arcachon has from the beginning been a local one, controlled by a local society composed of public spirited residents and scientific men of Bordeaux and vicinity. Prominent among those who have given largely of their time and effort to the station are M. Lamargue de Plaisence, the mayor of the village, and founder of the society, Dr. G. Hameau, president of the society for many years, and his son, Dr. A. Hameau, the present president, and Dr. F. Lalesque, its former president. The first formal director of the station, M. E. Durègne, an engineer, served from 1880 to 1886, when he was succeeded by Dr. H. Viallanes, who served until his death in 1894, being succeeded by the present director, Prof. F. Jolyet, professor of physiology in the medical school at Bordeaux.

The society at Arcachon consists of about 160 members with a council of administration composed at present exclusively of local representatives. This council appoints the director who has charge of the laboratories and aquaria. Officers of the society conduct the business and have charge of the library, aquarium, and museum. The connection with the University of Bordeaux is purely formal, insuring to the faculty and students of the university the privileges of the station, but not to the exclusion of others. The university has no formal control over the station and contributes nothing to its support beyond its membership fees. The scientific staff, consisting at present exclusively of members of the department of physiology of the university, receive no salary from the station, but enjoy its privileges for their researches.

The station has no endowment, but depends entirely for its support upon the fees of the members of the society and small annual grants from governmental and other sources. Its budget is as follows:

Receipts and expenditures of the biological station of Arcachon, 1908.

Receipts:	Francs.
Memberships.....	3,200
Subventions—	
Ministry of public instruction.....	500
Ministry of agriculture.....	200
City of Arcachon.....	2,000
French Association for Advancement of Science.....	300
Department of Gironde.....	500
Admissions to aquarium and museum.....	1,400
Sales.....	5,000
Miscellaneous.....	5,000
	<hr/>
Total.....	18,000
	<hr/> <hr/>
Expenses:	
Loan.....	600
Office and service.....	2,400
Buildings and materials.....	7,000
Laboratories.....	2,000
Aquarium and pisciculture.....	1,300
Printing.....	1,300
Museum and library.....	600
Upkeep and miscellaneous.....	2,800
	<hr/>
Total.....	18,000

The support of the station is most meager in view of the facilities already offered and the possibilities which the location affords for service to instruction and research. The exceptional opportunities for scientific investigation along zoological and oceanographic lines as related to the important fisheries of the Gulf of Gascony and to the manifold problems of ostreaculture as yet await development.

The small annual stipend received from the ministry of agriculture does not suffice for any systematic investigation along economic lines and indeed research in such lines is wholly voluntary on the part of the station. It has no obligatory relations to the economic or scientific interests of the fisheries. Professor Sauvageau has contributed in this field an important memoir (1907) upon the "greening" of the oysters of Marennes by a blue diatom, and other investigations of interest to the fisheries have been carried on in its laboratories.

The Arcachon station, in so far as the laboratories are concerned, is purely a research station, frequented mainly by professors from the universities of France, with occasional visits from foreigners. No effort is made to carry out any special programme of research,

each individual following his own independent work. Owing to the relation of the station to the department of physiology at Bordeaux, the equipment and work of the station is largely in physiological lines.

The station is open throughout the whole year, but the aquaria are not maintained during the winter months and only a few of the rooms are provided with heat. The station has ten private laboratories, some of which may accommodate two persons. The facilities of the station are offered without charge to French and foreign savants alike. About a dozen investigators avail themselves of this privilege annually. Application should be made in advance to the director or to the president of the society, stating the position and qualifications of the applicant and giving the list of instruments, glassware, chemicals, etc., necessary for the intended research. In so far as the limited budget permits, provision will be made of the necessary equipment. The aquarium, which is a source of income to the station, has first claim upon the material, but its abundance in general is such that no difficulty arises from this source.

The station also provides simply furnished lodgings, ten chambers in all, for workers at the station, at a modest charge of 7 francs per month for service; light and heat at cost. A copy of the rules governing workers at the station is sent on request.

Investigators are expected to furnish their own microscopes, but a microtome is to be had at the station. A résumé of all work carried on or completed at the station, wherever published, is to be furnished to the director for insertion in the "Travaux" of the station and acknowledgment of the utilization of the privileges of the station is expected.

The station renders a service to the popularization of science by maintaining an aquarium during the summer months and a museum of local natural history and antiquities and conducting occasional popular lectures on biological subjects. It also conducts a supply department, furnishing living material and fresh sea water for aquaria, making a specialty of *Hippocampus*, which abounds in the "Bassin." Living and preserved material for laboratory use is also supplied. A price list of material is issued.

From 1895 to 1908 the station issued somewhat irregularly a small publication bearing the title "Société Scientifique d'Arcachon. Station Biologique. Travaux des Laboratoires," the eleventh "Année" appearing in 1908. In 1908 the size of the publication was considerably increased, and in 1909 the title simplified to "Bulletin de la Station Biologique d'Arcachon." Much of the scientific work done at the station appears, however, in publications of the scientific society at Bordeaux and in journals elsewhere. A "Compt-Rendu Administratif" is also issued annually.

Arcachon is the most frequented of the local seaside resorts on the west coast of France, 56 kilometers southwest of Bordeaux, reached in one to two hours by frequent trains from that city. It is situated on the south shore of the Bassin d'Arcachon not far from the entrance of the great lagoon of 50 miles circumference and 60 square miles area, containing the most extensive oyster parks in France.

The station lies on the water front a few minutes walk from the railway depot, on the Rue de Debarcadère opposite the Casino. It is entered through the grounds of the Administration des Ponts et Chaussées from the Boulevard de la Plage. The plant, located in grounds containing 1,875 sq. m., consists of a group of buildings in part erected for the fisheries exhibition held in Arcachon in 1866, with accretions of later years.

The main building is a plain square structure of wood (14 by 15 m.), the "Musée-Aquarium," containing on the first floor a chemical laboratory (4 by 6 m.) with hood, cement table, and very simple fittings, a biological laboratory (4.5 by 5.5 m.), four furnished chambers for workers at the station and the corridor leading to the aquarium which lies in an annexed section at the rear (5 by 30 m.). The keepers' quarters occupy part of the ground floor of the main section and an adjoining part of the building. On the second floor of the main building are the library and museum.

The laboratories, storerooms, and shops are found at the rear of the main building, facing the Bassin at a distance of about 30 m. from the high-tide line and an elevation of about 2 m. above high tide. The building consists of two parts, a brick portion (3.4 by 36 m.) fronting the sea and an older wooden section (10.8 by 36 m.) at its rear. The brick building consists of a central section (4.1 by 14 m.) two stories in height with two wings (3.4 by 11 m.) of one story. The central section contains three rooms, the office and laboratory of the director and the laboratory of the assistant director, each of about 20 sq. m., while above are five chambers. The wings provide five other laboratories, four of about 15 sq. m. and a fifth 3.4 by 7 m. The larger laboratory is especially equipped for botanical work and is provided with three floor tanks of reinforced concrete (1.45 m. long, 0.7 m. wide, and 0.6 m. deep, with walls 6 cm. thick), a cement sink and sink table (0.5 m. wide, 3 m. long, 0.86 m. above floor with back 0.6 m. high) and a cement table (0.5 by 2.5 m. and 8 cm. thick). One of the laboratories is equipped for work in physiological chemistry, and three for work in physiology, while the remaining three serve for zoological investigations. One of the physiological laboratories is equipped with floor tanks similar to those of the botanical laboratories. Salt water is provided in all the rooms, but there is no further provision for permanent aquaria attached to the circulating system. The rooms are also provided with fresh water, gas, and a very simple equipment of a

peripheral shelf for work table, shelving, cupboards, etc. The rooms are abundantly lighted by the large north windows and are all entered separately from the wooden building to the rear. The two larger laboratories in the Museum building, with south exposure, are heated and may be used for work in the winter. The wooden building to the rear of the laboratory consists also of a central section and two wings, the former of two stories, containing above the reservoir and below a tool shop and dissecting room (4.4 by 7.5 m.) with dark room (2 by 2.4 m.) in one corner, and the engine room and store room (3.8 by 7 m.).

The two wings are open along their entire southern faces and serve as storerooms for tackle and fishing apparatus, while in their cement floors are sunk several large basins for the storage of material destined for the aquaria, for the laboratories, or the supply department. There are three of these tanks in the east wing each 2.2 m. wide and 10.2 long, with walls of cement 15 cm. (in the deepest 25) in thickness, and 30, 55, and 85 cm. in depth, respectively. In the west wing there are but two basins, one 2.25 by 10.2 m. and 45 cm. in depth, with walls 15 cm., and an incomplete central partition 6 cm. thick, the other 2.5 by 10.2 m. and 85 cm. deep with walls 25 cm. thick. These basins with their great surface exposure serve admirably for storage of fish and invertebrates and even of dolphins, which have been kept here in confinement for several months.

The equipment of the research laboratories of the station is intimately associated with that of the physiological laboratory at the University of Bordeaux, from which apparatus, chemicals, etc., are supplied for the time according to the needs of the investigators. The laboratory possesses a small equipment of physiological apparatus, not of recent origin, mainly for investigations on the physiology of nerves, muscles, circulation, and respiration. It includes a centrifuge and water motor, a Marey and Foucault registering apparatus, several myographs, cardiographs, and kymographs and the simpler electrical apparatus for recording physiological phenomena with a microscope for the accompanying photography. In the chemical laboratory there are several types of mercury pumps and other apparatus for analysis of gases, of water, and blood. There is also a simple equipment for bacteriological work consisting of an autoclave and ovens of Gay-Lussac and Roux.

The library of the station contains about 2,000 volumes, including a number of serials, early expeditions, and general works of French origin and a number of foreign exchanges as well as miscellaneous works of local interest. The collections include an exhibit of local archeology and antiquities, of the apparatus and methods used in ostreaculture, with models of oyster parks and photographs illustrating the various steps in the culture and marketing of the oyster. There is also a collection of oysters of the world, and one of the local fauna

and flora with maps and plaster models of the "Bassin" made largely in connection with the exposition of 1866.

The pumping plant of the station consists of a steel windmill supplemented by a steam pump of 2.5 horsepower. The water is drawn through a 6 cm. lead pipe and carried about 100 m. to a receiving tank near low-tide level. From the brass pump the water is carried in a 5 cm. copper pipe to the reservoir at an elevation of 3.5 m. The reservoir is of wood (3.3 by 7.8 by 0.8 m. in depth) with 3 mm. lead lining. The water is distributed from the reservoir to the aquaria and laboratories in lead mains of 6, 5, and 4 cm. and lead laterals 2.5 cm. carried to the bottom of the aquaria. The cocks and valves are of brass or brass matrix and wooden plunger.

The exhibition aquaria are arranged along one side of a long dark corridor (3 by 30 m.) at the rear of the museum. There are eighteen tanks 1.2 m. long, 1 m. wide, and 0.8 m. high, of about 1 cu. m. capacity, and four of two units each 2.4 m. long. The walls are of mortised slabs of gray marble 6 cm. thick, with partitions 8 cm. thick, held together with iron bands and joined in front to a cement frame with the bottom rail 6 cm. and the verticals 8 cm. wide projecting 5 cm. beyond the glass which is set in litharge in channels in the cement, with buffers of rubber. The openings are all 65 by 112 cm. and the glass for the small tanks is 0.8 by 1.2 m., in the large ones 0.8 by 2.05 m. and 15 or 20 c. m. in thickness. The longer panes have a central brace on the outside.

The water is used but once in the aquaria and owing to the considerable turbidity caused by the strong tidal currents is allowed to settle in the reservoir before using. There is no system of aeration nor of constant circulation. The water is renewed in each aquarium in the morning or oftener if the heat is considerable. It is possible, if the aquaria are not overpopulated, thus to keep the animals in fair condition with an exhibit of the littoral and bottom fauna of the Bassin.

The field equipment of the station consists of a new motor launch, the *Navicula*, 9.5 m. long, 2.1 m. wide, and draft of 0.7 m. with a 12-horsepower benzine motor of the automobile type (System Couach-Arcachon), of light construction with auxiliary sails adapted for work in the Bassin. There is also a pinnace, the *Hippocampe*, of 8 m. with sails. The station possesses the usual supply of dredges, nets, seines, trawls, and plankton nets of simple type, also a reversing thermometer, but no expensive equipment for work at sea or in deep water or for hydrographic investigations.

The environmental conditions at Arcachon present an exceptionally fine example of a tide-swept lagoon in open communication with the ocean, of wide extent (60 sq. miles), varying in depth down to 27 m. with numerous branching channels and wide areas (two-thirds

of the Bassin), left bare at low tide. The considerable movement of water with the changing tides, estimated at an average of 27,000,000,000 cubic meters, conduces to the growth of an abundant bottom fauna in the channels and a rich plankton, as is indicated not only by the collections of the station but also in a very conclusive manner by the extensive fisheries and oyster parks at Arcachon. The amplitude of the tides varies from about 2 m. at neap to 4 m. at spring.

The local fauna and flora are those characteristic of sandy shores and lagoons, with that of the mud flats found near the head of the lagoon and the few brackish waters near the entrance of the Leyre, a small stream which joins the Bassin. Although not rich in the number of easily obtained species, the quantity of material available is very considerable at Arcachon. *Verticillia*, *Sepia*, *Aplysia*, *Asterias*, *Hippocampus*, *Scyllium*, *Torpedo*, and *Trygon* abound, and *Amphioxus* also occurs. Of echinoderms 26, of crustacea 71, of mollusks 302 species have been recorded at Arcachon. The oyster parks afford an abundance of many of the smaller sessile tunicates, hydroids, and annelids.

The sardine fisheries, recently developed to a large extent, and the 40 to 50 steam trawlers which make their headquarters at Arcachon add also to the biological and ichthyological resources of the station. The fishing companies often render courtesies to the station in furnishing material or opportunities for collection.

An annex to the Arcachon station has been established at Guéthary (Basses-Pyrénées) near Biarritz, about four hours by train from Bordeaux, located on a rocky coast with its characteristic and richer fauna. The building is a simple stone structure of one room (3.54 by 4.69 m.) near the water's edge with simple furnishings for a field laboratory. A local fisherman serves as collector as needed.

Literature: *Compte Rendu Administratif* (1901-1908), Dean (1894), Sand (1897), Durègne (1886, 1888), Lalesque (1900), Jolyet et Lalesque (1904).

LABORATORY OF MARINE ZOOLOGY AND PHYSIOLOGY AT CONCARNEAU (FINISTÈRE).

Director, L. F. Henneguy, Professeur d'Embryogénie comparée, Collège de France, Paris.

Assistant director, Dr. Fabre-Domergue, inspecteur-général des Pêches Maritimes, Magasin Central de la Marine, 64 Quai Debilly, Paris. Residence, 208 Boulevard Raspail, Paris.

Resident naturalist in charge of the station, Dr. J. Guérin-Ganivet, naturaliste attaché au service scientifique des pêches au ministère de la marine, Laboratoire Maritime, Concarneau.

In addition, a keeper, a machinist, and a servant.

Telegraph address: Laboratoire, Concarneau.

The laboratory at Concarneau enjoys the unique distinction of being the first maritime laboratory founded in Europe. While it is true, as Sand (1897) has pointed out in the case of the Belgian laboratory at Ostend opened in 1843 by Prof. P. J. Van Beneden, that it is antedated by other enterprises, these have in all cases been of a temporary character, partaking rather of the nature of biological seaside excursions or summer laboratories for a few months of the year at the most, without permanent building or equipment.

In 1859 Prof. J. J. Coste, the French naturalist, opened at Concarneau this institution designed as a permanent station of biological research at the seaside. He was succeeded as director by Prof. Charles Robin, who shared the directorship with Prof. Georges Pouchet, of the Museum of Natural History in Paris. On the death of Professor Robin, in 1885, Professor Pouchet became sole director. Associated with him as assistant directors were Doctor Hermann, and later Doctor Chabry. Upon the death of Professor Pouchet in 1894 the laboratory passed to the hands of a council of directors named by the professors in the Collège de France.

The station at Concarneau is at present an adjunct to the Collège de France and is controlled by an administrative council, nominally known as "directeurs," consisting at present of Prof. Arsène d'Arsonval (medicine), L. Ranvier (general anatomy), E. Gley (physiology), and Henneguy (comparative embryology), all connected with that institution. This council nominates the staff of the station for confirmation by the minister of public instruction. The director is responsible to the council and minister and makes an annual report to the minister upon the progress and activities of the station. The entire conduct of the station is in his hands. At present both the director and assistant director are residents of Paris, and the immediate conduct of the station is in the efficient charge of the resident naturalist, Dr. Guérin-Ganivet, an attaché of the fisheries service.

The budget of the station is derived from two sources, an annual grant of 6,000 francs from the ministry of public instruction and one of 3,500 francs from the ministry of the marine. In addition a sum of 7,000 francs for salaries of the scientific staff is paid annually from other budgets, and the support of the fisheries inspection boat *Petrel* which the station employs in its field work comes entirely from the budget of the marine service. The income of the station is allotted as follows:

	Francia.
Office expenses.....	500
Library.....	1,000
Scientific research.....	3,000
Upkeep of building and equipment.....	3,000
Total.....	7,500

The station is maintained at present purely as a research institution, giving no instruction of advanced or elementary nature and maintaining no popular features such as public aquarium or general lectures. Its facilities are open without charge to all competent investigators, French or foreign alike, in so far as the room and limited budget of the station permit. There are 8 investigators' rooms, accommodating one or at the most two persons each. Applications for admission should be made in advance to the director, stating the time for which a table is desired and the material desired for research. Investigators should provide their own microscopes. They are supplied with the material for research or the facilities for collection, with the usual chemicals and reagents, are permitted to use the aquarium and dark room, library, and the other facilities of the station. The only charges made are those for containers and packing for material removed from the station.

The station also supplies gratuitously to investigators and educational institutions living animals and sea water for aquaria, and preserved material prepared by simpler methods, for research and instruction; the cost of containers, packing, and shipping being borne by the receiver. No list of material supplied has been issued. Collecting for museums and educational institutions is freely permitted, but not for commercial purposes.

In consequence of the annual grant from the ministry of the marine the station has assumed the obligation of preparing upon request of the minister special reports upon questions of the fisheries. The location of the station at a great center of the sardine, oyster, and lobster fisheries places it in an advantageous position to render assistance where scientific investigation is needed in the regulation and development of these industries.

The resident naturalist also carries on continuous investigations along lines of more or less direct relation to the fisheries. The subjects under investigation at present are the distribution and œcology of the edible mollusks of the region and the hatching and rearing of young sea bass (*Labrax lupus*) and of the lobster and crayfish (*Palimnurus*).

The station has no other programme of oceanographic or biological research. The investigations conducted at the station in the past have been numerous and important, appearing in many French journals, especially in earlier years in the "Journal de l'Anatomie et de la Physiologie," edited by its former directors, Robin and Pouchet. At present the reprints of work done here are issued in a series entitled "Travaux Scientifiques du Laboratoire de Zoologie et de Physiologie maritime de Concarneau" (1909+), and a new serial to contain the investigations at the station is planned to appear in the near future.



**A. INTERIOR OF PHOTOGRAPHIC STUDIO, BANYULS.
From photograph by Doctor Racovitz.**



B. VIVIER PLANNED FOR LOBSTER CULTURE. LABORATOIRE MARITIME, CONCARNEAU.



Concarneau is a quaint fishing town on the south coast of Brittany, much frequented by artists and tourists and full of interest to the visiting naturalist. It is reached in thirteen hours from Paris or in five hours from Roscoff, via Carhaix. The station is located immediately upon the rocky shore in the Ville Ouverte, across the channel from the ancient walled town, on the western side of the mouth of the harbor, between the small cove Kersos and the Baie de la Forêt. The building fronts on the Place de la Croix near the Halle a la Criée, where the daily auctions of the catches of the fishermen are held. It stands in restricted grounds of about 2,250 sq. m., including a small garden in front of the building with the residence of the assistant director attached thereto, and the large vivier or lobster basin on its seaward side. The building is a plain structure (8.75 by 30 m.) of nearly rectangular form, with massive granite walls. Its main axis runs nearly east and west and the working laboratories with one exception have a south exposure. The building stands immediately upon the water front and its basement is but 1 m. above ordinary high tide. It contains two floors; the upper, entered from the street, contains the laboratories and library, and the lower, the aquaria and storerooms.

The entrance leads directly into the central laboratory room (7.77 by 17.2 m.) on the main floor, from which open the library, dark room, tool shop, and the smaller private laboratories. About its walls are the cabinets for the collections, and the reagent and chemical cupboards, table for paraffin oven and blast lamp, and a Fabre-Domergue rotation apparatus with hot-air motor for rearing larvæ. There are also three large dissecting tables (1 by 2 by 0.8 m. high) and a cement sink. Adjacent to this are the library (3.25 by 5.4 m.), the dark room (1.25 by 3.3 m.), the tool shop, and from it open three small laboratories and the corridor leading to four others and to the well-stocked glassware room (3.3 by 4.35 m.). The private laboratories are 2.75 m. in length and from 2.1 to 3.65 m. in width, containing from 4 to 10 sq. m. of floor space. They are all well lighted by single windows, and in 1909 were in part renovated and refinished in excellent fashion. They are supplied with fresh water and gas, and have in some cases a work table (0.6 by 1.4 m.) facing the window, a sink of glazed fire clay and table of white tile, shelving of plate glass, and an abundance of compactly and conveniently arranged cupboards and cases of drawers. Sea water and aquaria with circulation are provided only in the basement. One of the rooms is equipped with a chemical table and is designed especially for chemical work. The central laboratory and one of the private laboratories are heated by stoves for work in winter.

In the basement are located the aquarium room (7 by 9 m.) and three large granite reservoirs, the machine room and large storerooms, used in part at least for commercial purposes.

The pumping plant consists of a 4-horsepower Durand gas (or petrol) motor with a brass horizontal plunger pump (Echirion). The sea pipe is about 8 m. in length and is of galvanized iron (6 cm. outside diameter) terminating in a perforated nozzle in one of the granite basins of the vivier. The mains are of 6 cm. lead pipe, the laterals of 4 cm. Cocks and valves are of brass. The aquaria are fed by overhead spray and have vertical standpipes with surface outflow.

The water is delivered from the pump into the communicating reservoirs, three in number, located in the basement at an elevation of 2 m. above the floor. These reservoirs have walls of granite 18 cm. thick laid up in cement, are of irregular form, and have a total capacity of about 60 cu. m. There is but little seepage through their walls. The pumping plant is supplemented by an "aeromotor" windmill, with brass plunger pump, drawing its water from the basin of the vivier.

The aquarium room (7 by 9 m.) is dimly lighted by two windows, in each of which are placed two of the aquaria. Upon the floor is a floor basin (2 by 3.2 m. and 0.5 m. in depth) with walls of granite slabs 14 cm. thick. Along the southern and western walls there is a peripheral floor tank (0.9 wide and 0.4 m. deep with cement walls 13 cm. thick) divided by adjustable partitions of wood or by granite walls. In this room are located also seven aquaria (Pl. XXII, A), all with copper frames set on bases made of marble slabs 3 cm. thick. There are two 1 by 0.6 m. and 0.2 m. deep, two 1 by 0.4 and 0.4 m. deep, two 1.25 by 0.7 and 0.4 m. deep, and one 0.5 by 0.5 and 0.2 m. deep. All have plate-glass sides 1 cm. thick.

The aquarium room is also provided with a Fabre-Domergue hatching apparatus equipped with small hot-air motor, driving six rotators, three in glass jars 35 cm. wide and 35 cm. deep, and three in a rectangular aquarium 7.5 by 0.4 m. and 0.4 m. deep, with wooden base and copper frame with plate-glass sides.

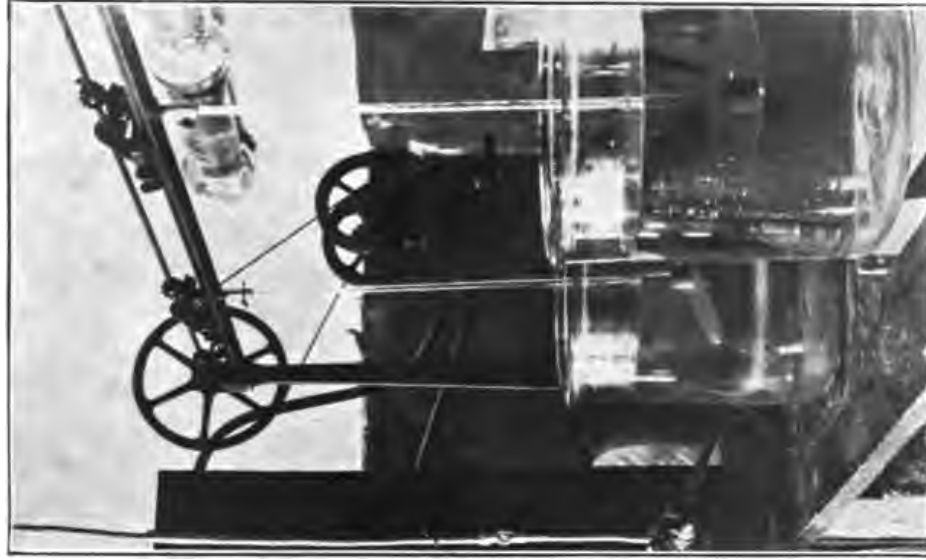
The Concarneau station is well equipped with glass ware, chemicals and reagents for morphological work. It has four microscopes, one of which is a high-grade Zeiss, and two Zeiss-Greenough instruments. There is also a Minot rotary microtome and several paraffin ovens. There is little equipment for physiological or chemical work, and as yet no adequate supply of aquaria or special provision for the purity of the sea water for experimental work.

The laboratory has a special aquarium with white background and large horizontal and vertical stands for photographing living animals, and a dark room for photographic work.

The station has a small collection of the local fauna, principally mollusks and fishes. The library contains about 2,000 volumes, mainly zoological, including especially works on fishes and fish



4. WALL AQUARIA.



B. FABRE-DOMERGUE ROTATOR FOR FISH HATCHING.
LABORATOIRE MARITIME, CONCARNEAU.



culture and a number of French serials and reports of expeditions, the *Challenger* reports, etc.

The marine equipment of the station itself includes a wooden motor boat, the *Sardine*, of 11 tons, 12 m. long, 1.9 m. wide, with a draft of 1.8 m. It has a 25-horsepower petrol motor, and is equipped also with mast and sail. It is provided with dredges for bottom collecting and nets for pelagic fishing. There is also a small sailboat, the *Coats*, of 1½ tons, 4.7 m. long and 1.7 m. wide, and two small boats for shore and harbor work, with the usual equipment of trawls, dredges, seines, nets, lobster and fish traps, and baskets.

The station is fortunate in having the use for work at sea and in deep water of the fisheries inspection boat *Petrel*, with headquarters at Concarneau. This is a steel steamer of 120 tons, schooner-rigged, with two masts and 400-horsepower engines, carrying a captain and crew of eight men and having berths for four scientists. It has no special laboratory. There is a steam winch of 1,500 kilos for dredging, etc., carrying 2,800 m. of galvanized steel cable 12 mm. in diameter. It is equipped with a Belloc sounding machine, with 1,000 meters of sounding wire and a Leger bottom sampler, Negretti-Zambra reversing thermometers, Richard water bottle, the large Richard plankton net, otter trawl and nets and fish traps.

A unique feature of the equipment of the Concarneau station is the large vivier, a group of large culture basins (Pl. XXI, B) extending seaward from the south face of the laboratory. The shore has been excavated and the sea front of the basin extends to low-tide level. The vivier is surrounded by a massive outer wall of granite whose lower part is 1.8 m. thick and 4 m. high. Upon this rises a protecting wall 2 to 2.4 m. above high-water level, to prevent damage to the basins by the storms to which it is exposed. The vivier, which contains about 1,350 sq. m., is subdivided into eight basins of different sizes separated by partition walls of granite 0.9 to 1.4 m. wide, whose tops serve as walks about the vivier. The open spaces are in part sheltered from the direct rays of the sun by loosely laid wooden covers. The vivier connects directly with the sea by a gate adjusted by lever and screw to regulate the inflow and outflow of tidal waters. Gratings in the partition walls permit the free circulation of the water between the several basins of the vivier. The basins were originally intended for use in pisciculture, and especially in lobster culture. They serve at present as storage basins for fish used in obtaining ova for hatching experiments and for storage of material obtained on collecting expeditions. A very considerable quantity of the normal shore fauna develops upon the rocky bottom and walls of these basins and is thus readily accessible under all conditions of weather to the naturalists at the station.

The station also has under its control on the Isles Glénau, three hours' journey by sea, a now dismantled fort which provides a field laboratory for naturalists visiting the rich collecting fields in its neighborhood.

The coast at Concarneau is rocky and much broken into fissures, clefts, scattered islets, and submerged rocks. It is constituted of a coarse diorite and of schists, with occasional stretches of white siliceous sands. The adjacent ocean bottom is generally rocky, often covered with the débris of calcareous algæ (*Lithothamnion*). Mud and sandy mud bottoms are rare. Depths in the Bay of Concarneau are 12 to 15 m. on the average, while between the coast and the Isle de Glénau, 10 miles to sea, depths of 25 to 30 m. are reached, diversified by many stretches of rocky bottom.

By virtue of its relation to the Gulf Stream the climate at Concarneau in winter is mild, the temperature rarely falling to freezing point, but in summer it rises to 32° to 35° C. The mean temperature of the sea water varies from 9° C. in December to 18° in July, and the salinity is practically that of normal Atlantic water. The location of the station on the open coast, the relative absence of sewage contamination, and the extensive movement of tidal waters makes available at Concarneau water of exceptional purity.

The character of the bottom and shores and the great tides insure a rich fauna and flora, especially that of the sessile or attached type while the sardine fisheries are proofs of the richness of the pelagic life. The tides, with a great amplitude at spring, make accessible to the shore collector wide stretches of rich collecting grounds abounding in rocks, beds of algæ, and tide pools. The fauna accessible at Concarneau is that characteristic of rocky bottoms. It is especially rich in cœlenterates, mollusks, gephyreans, bryozoans, and crustaceans. The algæ beds on the Isle de Glénau are reputed to be the richest on the coasts of France. The extensive fisheries for lobsters, crayfish (*Palinurus*), and sardines of the port add to the biological resources of the station.

Literature: Pouchet (1883, 1887, 1888, 1890, 1891), Francotte (1907), Guérin-Ganivet et Legendre (1909).

BIOLOGICAL STATION OF ROSCOFF (FINISTÈRE), FRANCE.

(Laboratoire Lacaze-Duthiers.)

Director, Yves Delage, professeur de zoologie à la faculté des sciences de l'Université de Paris. Laboratoire de Zoologie, La Sorbonne, Paris. At Roscoff, May-September.

Assistant director, Dr. E. Hérouard, maître de conférences, Laboratoire de Zoologie, La Sorbonne, Paris.

Preparators, M. F. Vlès and A. de Beauchamp, Laboratoire de Zoologie, La Sorbonne, Paris.

Naturalist, M. C. Schlegel, attaché au service scientifique des pêches maritimes, Roscoff.

Assistant preparator, M. H. Cozle, Roscoff.

Telegraph address: Laboratoire, Roscoff.

In addition, a captain, machinist, sailor, and a housekeeper.

“On chercherait en vain, je crois, sur nos côtes une position plus favorable.”—Lacaze-Duthiers, 1877.

Founded in 1872 on a subsidy of 3,000 francs per annum from the ministry of public instruction by Henri Lacaze-Duthiers, professor at the Sorbonne, one of the most famous of the zoologists of France in the past century, noted for his wide knowledge of the fauna of the several coasts of France and northern Africa and for his many monographs on marine animals, the station at Roscoff was at first intended only to be a temporary affair, a stopping place for an itinerant station which should move about the coasts of France. The difficulties and limitations of this plan and the marvelous resources of the location at Roscoff led the founder to advocate a permanent station at that place. Accordingly, in 1876 the rented quarters were abandoned and a house with a large garden near the water front vis à vis to the Île de Batz, which forms a protection against storms from the north, was purchased by the ministry for the station, and the institution was designated as the “Laboratoire de zoologie expérimentale.”

The director was fortunate in securing early in the history of the station the services of Ch. Marty, a naturalist fisherman, whose skill as collector, wide knowledge of the local fauna, and genial character, endeared him to a generation of investigators.

In 1881 the station was formally annexed to the Sorbonne, and in the interval between 1878 and 1881 its equipment increased by the gift of a boat, the *Dentalium*, from the French Association for the Advancement of Science, by the construction of a reservation or marine park on the south shore of the Île Verte in front of the laboratory and of the large vivier or basin adjacent to the station and the beginning of the aquarium building with special laboratory rooms.

In the interval between 1881 and 1891 the station gradually acquired an adjacent property, the communal primary school building, the site of the battery de la Croix from the war department and several private holdings separating the laboratory from the sea, thus providing the present ample grounds and unimpeded access to a considerable extent of the water front, and making possible the union of the series of structures in one connected establishment and the erection of a substantial reservoir of 125 cu. m. capacity and a suitable pumping plant.

In 1900, upon the death of the founder of the station, his pupil and for many years his associate, Prof. Yves Delage, succeeded to his chair and his post as director of the station. In 1908–9 the laboratory

was renovated, a new modern building constructed on the site of the old aquarium and laboratory, the number of research rooms increased to thirty-eight, the circulating system extended and improved, and the vivier modified and strengthened. These very considerable improvements in the equipment of the station were made possible by private subscriptions amounting to over 60,000 francs. Of this sum Professor Chalon (Namur, Belgium) gave 30,000 francs, in addition to his replanting the garden with semitropical plants, Prince Roland Bonaparte 8,000, the Prince of Monaco 5,000, Amis de l'Université 5,500, Baron Ed. Rothschild 5,000, Baron A. Rothschild 3,000, and other friends 7,150 francs.

The system of free tables, followed during the first thirty-seven years of the life of the station, was abandoned and the plan of rental at a fixed annual charge of 1,500 francs was adopted. The budget from the State was also increased by an annual grant of 10,000 francs. It is hoped that with the income thus available a station may be maintained entirely adequate to the demands which the twentieth century imposes upon those who seek to extend the horizon of knowledge in the field of marine research.

The laboratory at Roscoff is an annex of the faculty of sciences of the university at Paris and has always been connected with the chair of zoology at the Sorbonne. Its director is appointed directly by the minister of public instruction. There is no administrative council, the director being responsible to the minister through the dean and rector of the university. The staff is appointed by the director; a resident naturalist attached to the scientific service of the marine fisheries is, however, detailed by the minister of the marine for service at Roscoff.

The station is at present in a period of transition from the system of free to that of rented tables, so that any statement of its income is necessarily incomplete and of its expenditures impossible. The station receives regularly through the University of Paris an annual grant of 6,000 francs. Beginning with 1909 an additional sum of 10,000 francs is granted annually from state funds. From the ministry of the marine a sum of 3,500 francs is received each year in return for the work done and facilities furnished by the station to the scientific service of the fisheries. The salaries (6,300 francs) of the resident naturalist, assistant préparateur, and housekeeper are paid from the budget of the State. The other members of the personnel are members of the staff of the University of Paris and receive no additional salary for their services at the station. There are twenty-four tables available for rental. Prince Roland Bonaparte, Prince Albert I of Monaco, the Swiss and Russian Governments, and the Academy of Sciences at Berlin have each subscribed for one table, and negotiations are in progress for the rental of others.

Of the funds thus received from these various sources about 4,000 francs are paid for labor continuously employed, 5,000 francs is assigned to the library and the balance for improvements and up-keep.

The station at Roscoff provides both for elementary and advanced instruction and for research. Elementary instruction is offered to university students and qualified persons in the summer from July 1 to September. It consists of daily lectures and laboratory exercises on available material. The afternoons are left free for voluntary work and excursions. Advanced instruction intended for students beginning research is also offered from August 1 to October 1. It consists principally of the technique of investigation. No fee is charged for these courses of instruction, and they are open to all properly qualified persons desiring seriously to undertake the work. The room and equipment available for this function of the station are limited, the elementary laboratory accommodating but eighteen students.

A series of conferences or public lectures are given each summer by visiting naturalists and the staff on subjects related to their research. These are open to students and to the public. The aquarium is not, however, open to the public for exhibition purposes.

The main function of the laboratory is research, and to this end it is equipped and maintained. Its laboratories are opened to all investigators on written application to Prof. Yves Delage, director, à la Sorbonne, Paris, stating the date of arrival, the period of stay, and whether or not lodgings are desired at the station. The laboratory furnishes to those whose admission is authorized a separate private laboratory equipped with microtome, paraffin oven, reagents (limited in the case of expensive reagents), glassware, etc.; supplies the animals which can not be collected by the worker himself; provides an aquarium in the large aquarium hall with running water for the exclusive use of the investigator and permits the use of the boats for collecting excursions. Persons desiring to lodge in the station are provided gratuitously with a furnished bedroom. Ten francs per month is charged for service. The number of rooms is limited and the privilege of occupying one can not be guaranteed.

The station has thirteen free tables and twenty-four for which an annual rental of 1,500 francs is charged. A copy of the "Réglement du Laboratoire" is sent on application.

The investigators at the station are free to pursue whatever researches they choose and to publish their results as they wish. They are requested to leave named material, when feasible, for the collections and to assist in the series of public lectures, but neither service is obligatory. They are expected to furnish their own microscope

and accessories. By previous arrangement collections for laboratory and museum purposes as well as for research may be made, charges being made only for the cost of fluids, containers, and packing.

The Roscoff station is open throughout the whole year. It is most frequented, however, during May–October, the abundant rains and not infrequent storms of the winter season interfering somewhat with work in the field. Several of the laboratories are provided with heating facilities for use when needed in the colder months. Roscoff is no longer wholly a provincial village, and comfortable quarters at reasonable prices may be secured at several of the numerous hotels adjacent to the station. The foreigner will find much to interest him in the quaint life of the village and of other towns in the province of Brittany, should need for diversion in the close application to research arise.

The station from its foundation has been deservedly popular. During 1908 over one hundred persons were in attendance as students or investigators. Although its clientele is largely drawn from French universities, it is frequented also by naturalists from England, Switzerland, Belgium, Holland, Russia, and Germany, and several American investigators have enjoyed its privileges for research.

The station maintains throughout the year a supply department for furnishing living and preserved animals and sea water for research and instruction. The shipments are largely made by parcels post and by courtesy are extended not only to French institutions and investigators, but also to those of other lands. From 1,000 to 1,200 parcels are sent annually. No charge is made for the animals or labor. The recipient bears merely the expense of fluids, containers, and shipping. This service makes it possible to provide classes in the higher institutions of learning in France with living material of many marine forms for class use and adds greatly to the efficiency of instruction in these subjects. A copy of the regulations regarding this service is sent on application.

The Roscoff station has no immediate relation to the fisheries beyond affording facilities to the attaché of the scientific service of the marine fisheries for carrying on his investigations. Neither does it have any programme of investigation for its staff, save only the faunistic researches of the fisheries naturalist.

The magnificent series of faunistic, systematic, morphological, and embryological monographs, which have been published in the "Archives de Zoologie expérimentale et générale," started in 1872 by the founder of the stations at Roscoff and at Banyuls, attests the extent and value of the research carried on in these two leading stations of France by the individual investigators whose work has been facilitated or made possible by these institutions.



A. STATION SEEN FROM THE BREAKWATER AT LOW TIDE. THE "PLUTEUS" IN FOREGROUND



B. STATION BUILDING SEEN FROM THE CHURCH.
BIOLOGICAL STATION AT ROSCOFF.



The Roscoff station publishes at present no series of its own, but the plan of issuing a periodical is under consideration.

Roscoff is a fishing village on the north coast of Brittany, the center of a considerable local fishery, especially of lobsters and crayfish (*Palinurus*), and a port to which large quantities of *Palinurus regalis* are brought from the Senegal coast for preparation for the Paris market. It is growing in importance as a residence summer resort for Parisian families, but still preserves its picturesque and unspoiled simplicity. The station is located near the head of the promontory which projects toward the Isle de Batz. It is about ten minutes' walk from the local railway station. The buildings front upon the Place de l'Église adjacent to the picturesque old church of Notre Dame du Croix Batz and to the west open upon the Promenade du Ville along the shore. The grounds are extensive, occupying about 6,000 sq. m. of land extending along the water front for a distance of about 80 m. and projecting seaward in a large vivier. The buildings of the station represent the accretions of forty years and include not only the new modern laboratory erected in 1909, but at least five more or less ancient dwellings in the style of the "renaissance Bretagne" of the beginning of the seventeenth century, which have been converted to the uses of the institution. The buildings are separated from the strand by a narrow terrace 5 to 10 m. wide and stand 1 to 2 m. above high tide. They are arranged (Pl. XXIII, *B*, and text figure 7) upon two sides of the walled garden (Pl. XXIV, *A*), the new laboratory (10 by 55 m.) forming a wing running nearly east and west, joining at its eastern end the row of older buildings, which run at right angles to it southward for a distance of 65 m. This older wing includes five connected houses fronting upon the Place de l'Église. The new laboratory is two stories in height and the older buildings two or three. Adjacent to the corner of the two wings is a large reservoir (7 by 30 m.) with a laboratory beneath (fig. 7, *Q*), standing upon the foundations of the old battery of La Croix. The station thus possesses about 2,500 sq. m. of floor space in its various buildings.

The first building at the southern end of the eastern wing is the keeper's lodge (*L*, fig. 7) and that at the northern end is in part (*F*) the residence of the director and in part on the ground floor, machine room (*D*), and tool shop (*E*). The intervening buildings, three in number, contain on the ground floor a series of rooms, the first of which (*K*) is the general laboratory (7 by 7 m.) used for elementary instruction. This is abundantly lighted by its two glazed sides and has table accommodations for eighteen students. It is furnished with an oval central table of reenforced concrete (1.2 by 2.3 and 0.95 m. high) with concave top and raised lip and a sink (0.5 by 1.6 m.) of the same material. It is adorned with a bust of the founder of the

station, Prof. H. Lacaze-Duthiers, a replica of the bronze given to the Sorbonne by the faculty of the University of Barcelona. From this room a corridor leads along the rear of a series of seven rooms each approximately 4.5 by 5 m., serving as the laboratory (*K*) of the préparateur, physiological laboratories (*I* and *C*), storeroom for chemicals,

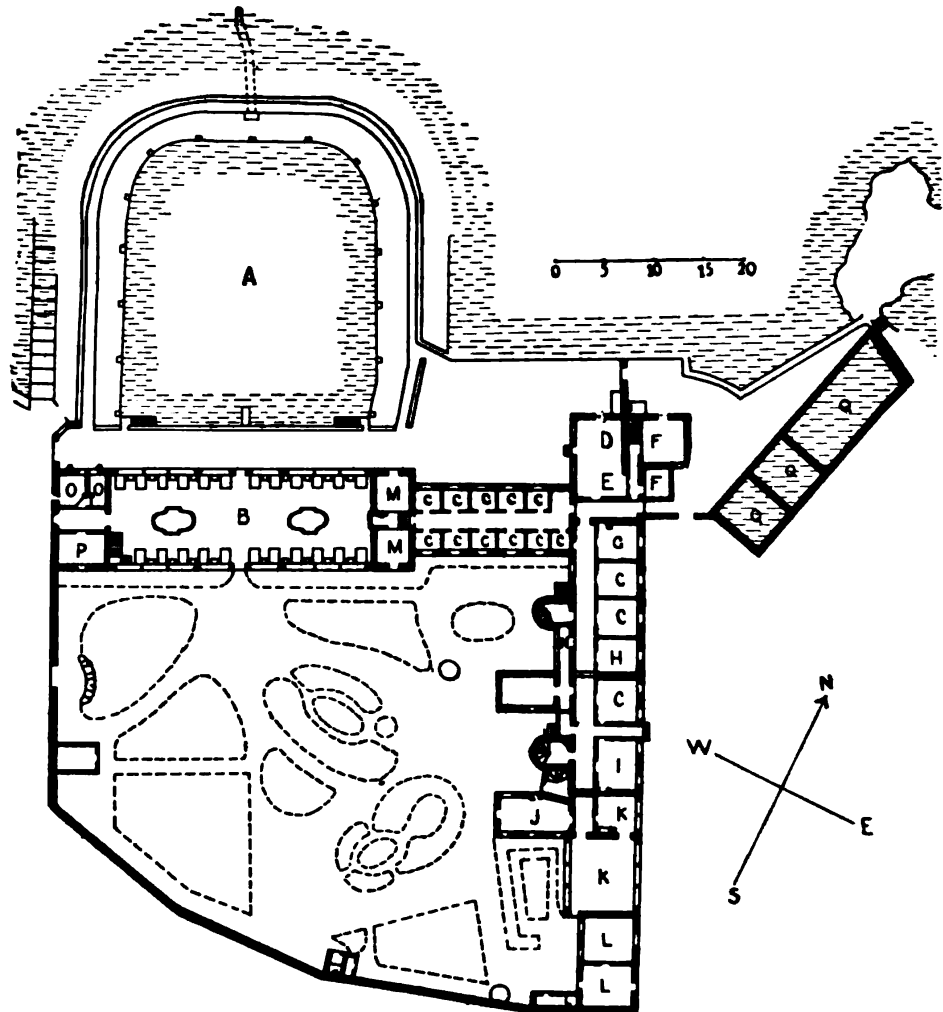


FIG. 7.—General plan of ground floor of station buildings at Roscoff: *A*, vivier; *B*, aquarium room; *C*, laboratories; *D*, engine room; *E*, machine shop; *F*, director's residence; *G*, chemical laboratory; *H*, glassware and reagents; *I*, physiological laboratory; *J*, room for zoological psychology; *K*, students' laboratories; *L*, keeper's lodge; *M*, vestibule and stair well; *N*, laboratory of préparateur; *O*, dark room; *P*, tackle and net room; *Q*, sea-water reservoir; *R*, conduit for sea water; above *K*, library and museum; above *B* and *C*, *C* of western side, investigators' laboratories; below *Q*, director's aquaria.

reagents, and glassware (*H*), private laboratories (*C*, *C*), and chemical laboratory (*G*). The chemical laboratory contains a chemical hood, furnace, precision balances, chemical worktable, and a tile table and sink. It was equipped for the laboratory by the society of "Friends of the University" at Paris.



A. GARDENS OF THE STATION WITH THE NEW LABORATORY.



B. THE VIVIER.

BIOLOGICAL STATION AT ROSCOFF.



The laboratories in this part of the building are generally provided with stoves or fireplaces and are simply furnished with table, a table with lead-lined tray for dissecting and aquaria, and with suitable shelving.

In the second story of this wing, above the general laboratory, is a large (7 by 7 m.) well-lighted collection room containing glazed exhibition cases and lockers for the zoological, botanical, and geological collections illustrative of the natural history of the locality. Adjoining this is the library (3.5 by 7 m.). The remainder of this floor and the one above contain the eighteen chambers for students at the laboratory, which are simply but adequately furnished.

The two projecting towers on the garden side of this wing of the building contain the helicoidal stairways ascending to the upper stories, while in the two small wings on the ground floor are found a room (*J*) assigned to members of the "Institut général psychologique" for investigations in animal psychology and a storeroom (*N*) for alcohol and glassware.

The new wing (10 by 55 m.), entirely reconstructed in 1909 with granite facing and reinforced concrete walls, floor, and roof, is a model of simplicity and effective construction adapted to marine research. The roof, of concrete covered with bitumen and loose gravel, forms a terrace of over 500 sq. m., with commanding view over the adjacent coasts and waters dotted with islands and projecting rocks.

Upon the ground floor at the western end are the tackle room (*P*, 3.5 by 4 m.) and the two dark rooms (*O*, *O*, 2.65 by 3.7 m.), the large aquarium hall (*B*), the main entrance (*M*) from the garden and lobby, and opening on both sides from a central corridor 10 research cubicals (*C*, *C*, 2.53 by 3.85 m.), each with one window 1 m. wide. Each room is provided with a sink, table of concrete (0.5 by 3.85 m. and 0.75 m. high) with lip and fresh and salt water supply. The table slopes to a sink near one end 0.5 m. long. There are tables 0.6 m. wide, across one end and along one side of the room affording about 2.6 sq. m. of table area. There is about 15 m. linear measure of shelving in each room. Partition walls between these rooms reach the ceiling, but that along the corridor is incomplete above, affording ventilation.

The entire upper floor of the western wing is given up to research laboratories opening from a central corridor 1.5 m. wide. There are twenty-five of these rooms, the space of one being taken by the centrally located stair descending to the aquarium hall below.

These rooms are entirely separate from each other and from the corridor. They are nearly square (3.85 by 3.9 m.) and contain 15 sq. m. of floor space each, with the exception of the pair at the western end, which are slightly wider and contain 21.6 sq. m. floor space.

The ceilings are 3.3 m. high and ventilation is provided by transom windows into the corridor and a swinging sash in the window. Nearly the entire front of each room above the table is glazed, the sash (*J*) measuring 2 by 3 m. with iron frame work and panes 35 by 50 with a central pane at the level of the table 75 by 100 cm. for microscopical purposes. The floors of the rooms and of the corridors are of porphyrolithe or "wood-stone" in red tone with dark-brown border. This

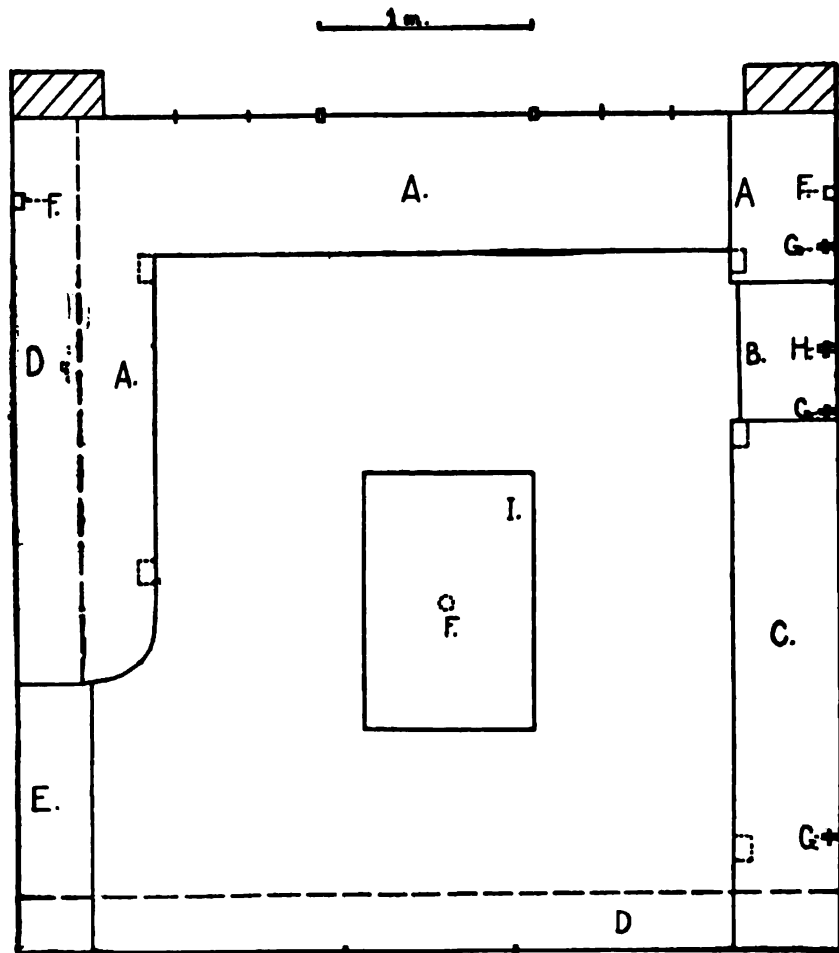


FIG. 8.—Fittings of investigators' room, Roscoff station: *A*, table with linoleum top; *B*, sink; *C*, cement aquarium tables; *D*, shelving above table or door; *E*, electric sockets (one above table *I*); *G*, salt-water taps; *H*, fresh-water tap; *I*, movable table; *J*, window with large central sash.

is a water and fire proof compound laid directly on the cement and lapped upon the base of the walls to a height of 8 cm. It makes an ideal floor for a laboratory, being easily cleaned, dustless, waterproof, slightly elastic, and not so cold as cement.

The rooms are simply furnished (fig. 8) with a sink table (*C*) of reinforced concrete (6 cm. thick) on one side (0.55 by 3.9 m. and 0.72 m. high) sloping to the sink (*B*, 0.5 m. long) near the front of the room. The table has a marginal lip and four taps for salt (*G*) and one for

(H) fresh water. Across the window and at one side of the room are shelf tables (A) of wood covered with linoleum (0.65 m. wide and a total length of 5.3 m. and 0.72 m. high) affording about 3.5 sq. m. of table space. There is also a central writing table (I, 0.8 by 1 m.), a cupboard (E, 0.35 by 1.25 m.), and 5.3 m. of shelving (D). The rooms are lighted by electricity, having a central droplight and desk lamp and two side sockets (F) at the microscopical table for electric thermostat and hot plate.

The station possesses an additional aquarium room (7 by 7 m.) and adjacent laboratory (5 by 7 m.) for experimental embryology, the private laboratory of the director, in the building beneath the large reservoirs (fig. 7, Q).

The pumping plant of the Roscoff station is an 8-horsepower electric motor attached to a Dumont (Paris) centrifugal pump of brass, making 1,400 revolutions per minute, with an inlet of 45 and an outlet of 65 mm. The sea pipe and mains to the reservoirs are made of cast-iron pipe (8 cm. inside diameter) of the system "joint petit" (see La Harpe, "Notes and Formules de l'Engineur, etc.," 15th ed., 1907, p. 434), which permits the removal of any section without disturbing adjacent parts. The pipe is asphalted and has rubber packing in the joints. The sea pipe is about 20 m. in length, ending in a perforated globe in the vivier. The water is pumped to two reservoirs. One supplying the aquarium hall and the lower floor of the laboratory is placed in part on the granite foundations of a former battery adjacent to the station. This reservoir is of reenforced concrete 7 by 30 m. and 1.5 m. deep, with a capacity of 130 cu. m., with walls, floor, and roof 15 cm. thick. It is divided into three independent compartments, each with its own open ventilator (0.5 by 0.5 m.) and flushing pipes. The water is delivered from the pump into a cement channel on the roof (0.3 by 0.3 by 7.5 m.), discharging into the three compartments.

The second reservoir is placed on the roof of the lower building above the machine room. It is also of reenforced concrete and measures 5.4 by 11.8 m., with a depth of 1.2 m., walls 15 cm. thick, and a capacity of about 66 cu. m. It supplies the laboratories on the second floor and is connected with the lower reservoir. The distributing mains are of 6 cm. (outside diameter) soft-lead pipe, laterals of 4 and terminals of 2.5 cm. The cocks in the pipe are of brass. The outflow is regulated by hard-rubber cocks fastened with rubber packing in the ends of the lead pipe, provided with removable threaded tips of hard rubber, with orifices 0.5 to 2 mm. in diameter bent at an angle of 45°. The jet is discharged at a height of 10 to 20 cm. above the aquarium into a glass jar, whose overflow is practically free from the air bubbles carried down by the jet. The aquaria are drained by vertical standpipes of glass set in centrally located corks

with or without a siphon of lead or glass tubing to remove bottom water. The discharge from the aquaria is carried by rubber and glass tubing into 5 cm. cast-iron pipe along the wall, which in turn delivers the outflow to the floor tanks. The floor tanks discharge into cast-iron pipes in channels in the cement floor. The water is passed but once through the system, and, with the exception of the floor tanks, each aquarium has its independent circulation.

The aquaria at Roscoff are all intended for the purposes of scientific research and are not arranged for exhibition purposes. There are forty-four separate tanks placed in the large aquarium hall (10 by 30 m.), arranged along the sides of the building (Pl. XXV, A), which is brilliantly lighted by windows which completely fill the whole walls between the supporting pillars and above the level of the aquarium tables. The illumination is heightened by the white walls and ceilings. The light is thus superb for purposes of observation. To prevent the deleterious effect of excess of light upon organisms in the aquaria, wooden covers are provided and adjustable screens for the windows are arranged along the south wall. Certain aquaria are completely inclosed in opaque shelters (Pl. XXV, B.)

The aquaria are of various sizes and proportions. There are twenty-four on granite tables (0.8 by 1.2 m. and 0.9 m. high and 13 cm. thick) some of which have been in use for over twenty-five years without signs of deterioration. These aquaria stand with their ends toward the window (Pl. XXV, B). Between the granite tables there are cement shelves 0.35 by 1.35 m. and 5 cm. thick) supported by wall brackets on which stand aquaria with their long faces toward the window. The aquaria have iron uprights of angle iron (2 by 2 or 3 by 3 cm. and 4 mm. thick) set in the base. The tall aquaria (40 cm.) and the longer ones (133 cm.) have a top frame also, either of adjustable rods of iron or of small angle iron (1.5 by 1.5) fastened by screws to the uprights. The four faces are of plate glass 0.8 or 1.2 cm. thick set in common putty with the inner angles filled with litharge cement covered with glass strips, and the whole varnished with asphaltum. There is little or no leakage from the aquaria.

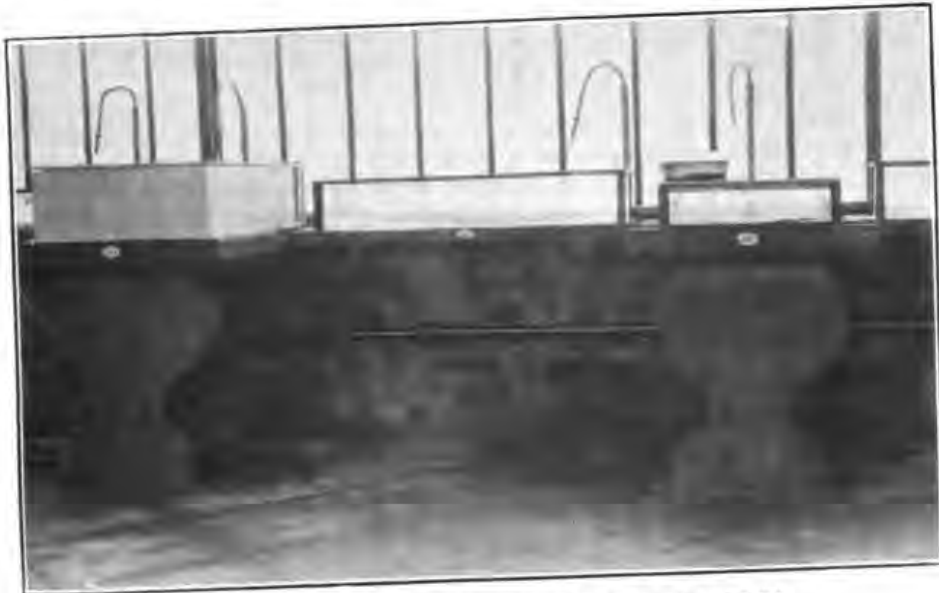
The dimensions used are the following (measurements in centimeters):

Dimensions of observation aquaria at Roscoff.

Height.	Width.	Length.
14	60	88
21	67	95
25	55	82
26	67	94
28	56	88
28	61	88
20	26	113
20	26	133
40	17	133



A. INTERIOR OF THE AQUARIUM ROOM, SHOWING WORK TABLES, FLOOR TANK, AND AQUARIA.



B. AQUARIA OF SEVERAL FORMS, TO THE LEFT WITH COVER,
BIOLOGICAL STATION AT ROSCOFF.

The floor of the aquarium hall contains two centrally located floor tanks, 3 by 5 m., with rounded ends (Pl. XXV, *A*), with walls of granite, 33 cm. high. The water is maintained at a depth of about 20 cm. and comes from the small aquaria. They also have an independent supply to be used when any of the small aquaria contain contaminated water or are used for experiment with poisonous materials. These tanks serve for the storage of a great variety of animals. The floor of the aquarium hall has peripheral channels 10 cm. wide and 15 deep covered with removable boards, with cross channels 20 and 30 cm. in width. These serve to carry the waste pipes which are thus easily accessible, and also to receive and carry off any accidental overflow and the water used in cleaning the floor.

In the room beneath the large reservoir is an aquarium used by Professor Delage in his famous experiments in rearing sea-urchin larvæ parthenogenetically produced by the use of CO₂. These aquaria stand on a U-shaped table of reenforced concrete 0.7 m. wide and 12 cm. thick and 0.8 to 0.95 m. high. It carries 13 aquaria (0.5 by 1 m.), joined in one circulating system, 15 cm. deep at the upper and 29 at the lower end. They are separated by cement partitions 7 cm. thick, and the side of each is formed by two panes 47 cm. long and 15 to 30 cm. high, according to its location, cement posts 7 by 7 cm. standing midway on each side. The windows of the room have adjustable wooden shutters to reduce the light.

The station at Roscoff has a superb equipment for the collection and study of living animals under the natural conditions of their usual environment. It consists on the one hand of a large vivier or shore aquarium, accessible under all conditions of weather and tide, absolutely protected from destruction, and provided with adequate means of change of water under satisfactory conditions. This artificial preserve is supplemented on the other hand by a natural park on the adjacent shore, under the control of the station, where the fauna may be allowed to develop undisturbed except as needed by the station.

The vivier of the station (Pl. XXIV, *B*) is specially arranged for biological purposes. It serves as a reservoir from which the water for the station is pumped and as a storage basin for large animals and for animals under culture or observation. It is a square basin (about 36 by 36 m.) with rounded outer corners jutting from the shore seaward, containing nearly 1,000 sq. m. of surface. A heavy wall of masonry 4 m. thick at the base forms its outer boundary. On the inner side of this wall is a reenforced concrete platform 4 m. wide supported by pillars of the same material. The faces between the pillars are closed above the water level by doors of tarred planking, thus forming a dark gallery, 70 m. long and 4 m. wide, where shelter-loving, fixed animals readily develop under quite natural conditions.

The bottom of the vivier is made of concrete and slopes from the margins (3.5 m.) to the gate (4 m.), facilitating the cleaning when necessary and insuring the retention of the water at times of low tide.

From the vivier a cement conduit (fig. 7, *R*) 0.8 m. in diameter, extends seaward for about 100 m. to a point near low-tide level. By means of this the vivier can be filled at high tide with pure sea water from the channel relatively free from shore contamination. The conduit is closed with an iron gate regulated from the platform by a screw.

The marine park is situated between the Isle Verte in front of the laboratory and the vivier, at some distance from the island on a rocky strand exposed at low tide. It is set aside under the exclusive control of the station as a collecting ground where continuous observations may be made on animals in a natural habitat or where cultures may be conducted. It is a rectangular area 25 by 50 m. inclosed in a wall of loose granite rocks and containing many rocky shelters for the protection of the fauna.

The marine equipment of the Roscoff station includes a wooden cutter of 18 tons, the *Pluteus* (Pl. XXIV, *B*), with a 3-cylinder 30 horsepower "Wolverine" motor for auxiliary power. The boat is 13.6 m. long, 3.35 m. wide, has a draft of 1.7 m., and carries two masts with full rigging for sails. There is a cabin 4.5 m. long forward with worktable and bottle racks and a galvanized-iron live box amidships with free circulation to the outside. Circulation is assured by having the water for the motor-jacket drawn from this well. The dredging winch is on the starboard side geared to the motor forward of the cylinders, and a friction belt connects the gearing with the cable drum on the port side of the engine room. The cable is passed through the deck forward between rollers on the prow. The vessel is driven backward while dredging. The *Pluteus* carries 320 m. of 15 mm. galvanized-steel cable, and shorter lengths of smaller sizes.

The station also has two sailboats, the yawl *Laura* of 2 tons, 6.5 m. long, and the *Bayard* of 0.75 ton, 3.5 m. long, and three rowboats.

The field equipment includes a 10 m. and a 4 m. beam trawl, a coral tangle, an assortment of nets, seines, and dredges, a large plankton net on the Hensen model, and small plankton nets for use at full speed. For oceanographic work there is a Mill water bottle, a Leger bottom sampler, and a reversing thermometer. For continuous record of temperatures in the channel about 850 m. from the laboratory there is installed a Fournion self-registering thermometer. A receptacle of liquid carbon dioxide at the field location is connected by a small copper tube with the registering apparatus in the laboratory. With this apparatus it is possible to obtain a continuous record of the temperature and to see at a glance in the laboratory at any time the temperature of the sea water at the field location. A Fournion self-register-

ing tidal gauge with a continuous record accessible at all times in the laboratory is also installed at the station.

The laboratory possesses an ample equipment of glassware and chemicals and a number of pieces of physiological apparatus, the gift of Professor Richet, including a Verdin registering apparatus and signal, a Marey myograph, and a Du Bois-Reymond electro-physiological apparatus. Other instruments are supplied from the laboratories of the Sorbonne in Paris as needed, not only for physiological work but also for morphological investigations, the damp winter climate at Roscoff making it difficult to keep fine instruments at Roscoff continuously. The station keeps at Roscoff, however, an equipment of microscopes, of dissecting lenses of Lacaze-Duthier's model and several microtomes and brings for summer season, June-October, a generous equipment from Paris. One of the older laboratories is amply equipped for chemical work and one of the new ones is to be equipped by the Prince of Monaco for oceanographic investigation. A Fabre-Domergue rotator apparatus with hot-air motor for rearing larvæ is also provided.

The buildings are lighted by electricity and the new laboratories are supplied with fresh and salt water and it is expected that gas will shortly be available in Roscoff.

The library of the station is as yet undeveloped. It contains about 2,000 numbers, coming in part from the library of Professor Lacaze-Duthier, mostly monographs, special works, and reprints, but it is to be largely increased in the near future. The museum is intended to illustrate only the local fauna and flora. It includes a well labeled and mounted and well displayed collection of the marine life of the vicinity, quite complete and carefully identified, often by specialists, the sponges by Topsent, isopods and amphipods by Chevreux, echinoderms by Mortensen and Hérouard, nemerteans by Oxner, planarians by Francotte, annelids by Pruvot, Fage, and Joyeux-Laffuie, bryozoans by Jolliet, parasitic copepods by Quidor, decapods by Delage, gastropods by Vasseur, Robert, and Hecht, *Amphineura* by Vlès, lamellibranchs by Vasseur, cephalopods by Vasseur and Camus, ascidians by Pizon, and the fishes by Marty, Guitel, and Moreau. The collection of seaweeds is from the herbarium of Professors Chalon and Siderot and contains about 500 sheets and a number of microscopical preparations. A card catalogue is kept of the collections, with notes on localities and authority for the determination.

The museum also contains an interesting collection of abnormalities, of sexual products and larval forms, and of materials representing experimental work carried on at the station.

The environmental conditions at Roscoff are such as to make easily available for research an abundant and varied fauna. The shores of

granite and schist afford a firm substratum for great beds of *Fucus* and *Laminaria*, and great stretches of shingly beaches provide *Ulva* and *Enteromorpha* zones, while in the deeper waters *Zostera* abounds. The extreme diversification of the coast line, with the numerous bays and promontories and many islands and jutting rocks, afford a shore of great extent and variety within a relatively short distance of the station. All conditions of rock, shingle, sand, and mud, each with its characteristic fauna and flora, are to be found close at hand.

Added to this variety of shore is the fact of a wide tidal amplitude reaching 8 and exceptionally 9 or 10 m. at spring and exposing to the shore collector, without the aid of boat or dredge, vast expanses of rock and weeds with tide pools, mud and sand flats of infinite variety. The collecting grounds are, moreover, immediately accessible from the doors of the laboratory and the naturalist enjoys direct and easy access to his material and exceptional opportunities to observe its natural habitat. Owing to their extent there is, moreover, little danger of the exhaustion of the collecting grounds.

The adjacent region for a distance of 5 to 10 km. from shore is within the 50 m. line. A limited region of 110 m. depth is found at a distance of 16 km., while the 100 m. line in general is 45 to 50 km. to the northwest. The bottom and pelagic fauna of deep water is therefore not generally available at Roscoff and the plankton as a rule receives large neritic contributions. The fauna in general is quite similar to that of Plymouth. (See p. 163.) A full account of the local conditions and the distribution of the local fauna will be found in the paper of Pruvot (1897).

Temperatures range from 4° to 5° C. in winter to 18° to 20° C. in summer. The winter climate at Roscoff is mild, figs, camellias, palms, and pelargoniums living in the open air, and freezing weather and snow being unusual.

The considerable movement of tidal water and the absence of large streams in the neighborhood insure nearly the normal salinity to the water at Roscoff, while the distance from large cities and the location of the laboratory upon a promontory projecting some 5 kilometers from the coast line remove the possibility of any considerable contamination. The water for the station is taken at highest tide once in two weeks through the cement pipes extending seaward 100 m. from the vivier. The impounding permits all suspended matter to sediment and the smooth cement floor is cleaned each time before admitting the fresh supply. The purity of the water supply at Roscoff is thus noteworthy.

The station at Roscoff affords unusual attractions to naturalists wishing work upon the littoral and neritic fauna, to study living animals in their native habitat, to secure large quantities of material, or to carry on developmental or experimental studies where aquaria

with pure water supply are essential. A cordial welcome is extended to all foreign guests.

Literature: Lacaze-Duthiers (1874, 1877, 1881, 1891, 1898), Dean (1894), Sand (1897), Pruvot (1897), Francotte (1907), Menegaux (1905), Delage (1908, 1909).

MARINE LABORATORY OF THE NATIONAL MUSEUM OF NATURAL HISTORY AT TATIHOU NEAR SAINT-VAAST-LA-HOUGUE (MANCHE).

Director, Prof. Ed. Perrier, director of the Museum of Natural History and professor of comparative anatomy, Museum d'Histoire Naturelle, 57 Rue Cuvier, Paris.

Assistant director, Dr. R. Anthony, 55, Rue de Buffon, Paris. January, April, and July-August at Saint-Vaast-la-Hougue.

Superintendent, M. A. E. Malard, Saint-Vaast-la-Hougue.

Captain and machinist, M. Ch. Liot, Tatihou.

In addition, one sailor and one servant.

Telegraph address: Laboratoire, Saint-Vaast-la-Hougue.

The granitic coast of Saint-Vaast and its vicinity with its rich fauna has long attracted naturalists to its study. From the time (1831) when Audouin and H. Milne-Edwards frequented these shores in the summer months, and opened temporary laboratories in hotels or fishermen's cottages, to the present, a long line of illustrious investigators, A. Milne-Edwards, Nordmann, Keferstein, Claparède, Grube, Brandt, Quatrefrages and many others from France and foreign lands, have sought these shores for the study of marine life.

A permanent station here was not established until 1881, when upon the petition of the professors at the National Museum of Natural History the station at Saint-Vaast was created by the minister of public instruction, and Prof. Ed. Perrier, a leader in the enterprise, was made its director. Under his charge its resources have been developed and it has been brought to a high state of efficiency. In this undertaking he has had the able services of M. Malard, for many years resident naturalist of Saint-Vaast and since 1906 the efficient aid of Doctor Anthony, the director-adjoint, who has given much attention to improving the marine equipment and developing its piscicultural features.

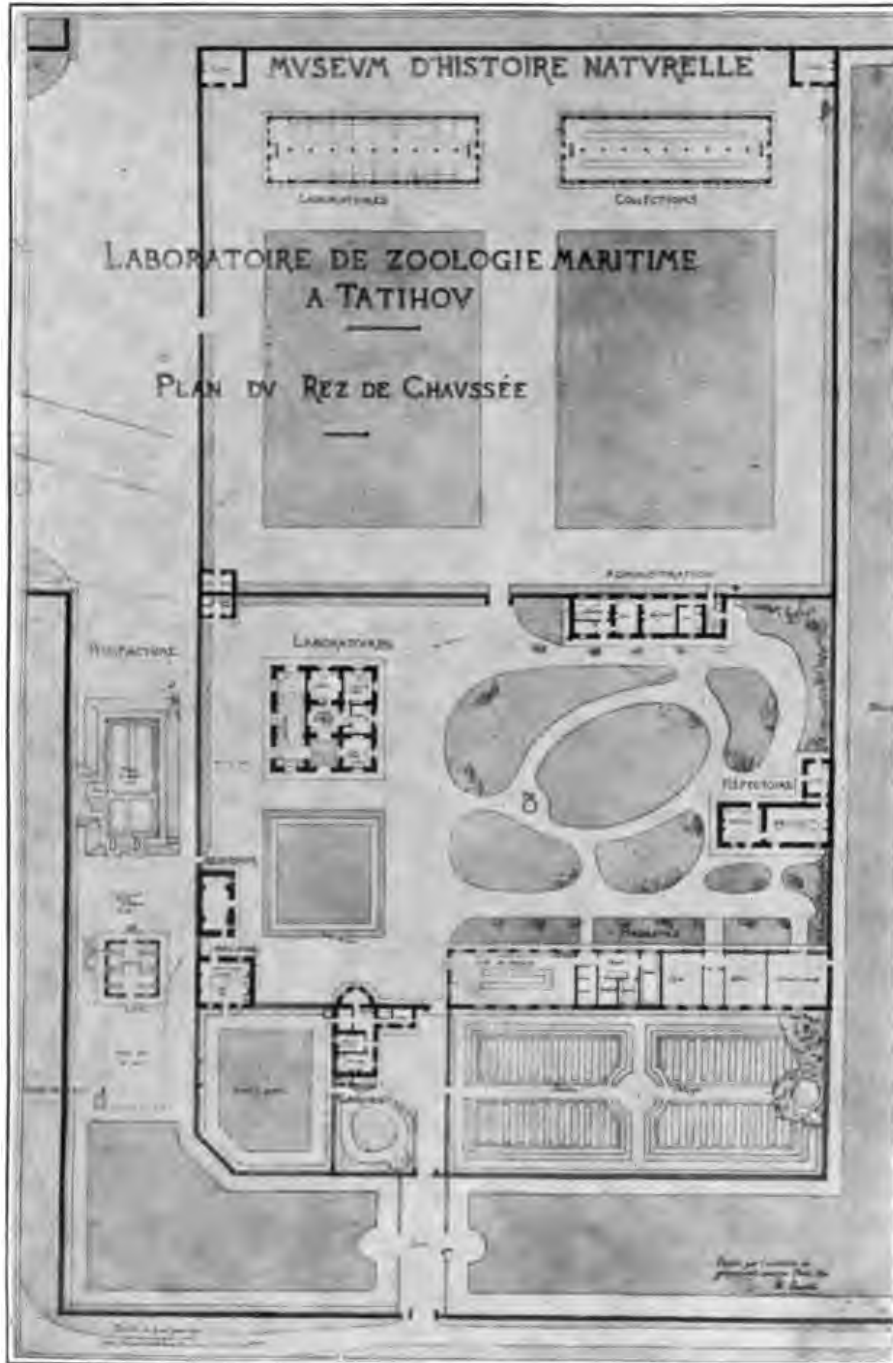
The director is appointed by the minister of public instruction and the other members of the staff by him also, upon the nomination of the director. The director-adjoint has immediate charge of the station and is in residence at Saint-Vaast for four months of the year. The superintendent (chef-de-travaux) is in continuous residence and has immediate charge of the laboratories, aquaria, and collections. The station is fortunate in its patron-mechanician, M. Ch. Liot, to whose knowledge of local conditions and courteous attention visiting biologists owe much. The assistant director makes annual administrative report of the scientific operations of the station which is published in the "Annales des Sciences Naturelles (Zoologie)".

The station is attached directly and solely to the National Museum of Natural History at Paris, of whose staff its directors are members. Its annual budget is included in that of the National Museum of Natural History from the ministry of public instruction, and consists in addition to the salaries of the director and assistant director, whose services are given mainly to the museum, of about 3,500 francs per annum for salaries of resident staff and subalterns, 4,170 francs for upkeep and equipment, a variable sum (3,000 francs in 1908) from the ministry of the marine, and an annual allotment (2,000 francs in 1908) from the ministry of fine arts for maintenance and repairs of the building, a total (in 1908) of 12,770 francs. Of the unassigned sum (7,170 francs) 5,170 francs are spent in maintenance of the boats, aquarium, grounds, laboratories, and collections, 1,000 francs for instrumental and chemical supplies, and 600 francs for the library.

Research is and has been the main object of the Saint-Vaast station. Since the museum conducts no examinations for degrees, the laboratories are not much frequented by students, but principally by investigators including many foreigners from Russia, Scandinavia, Germany, Switzerland, England, and Spain. Competent students and investigators are admitted on application to the director without charge. Investigators are supplied with private laboratory, chemicals, reagents, and glassware and material for research or the means of collection. Furnished quarters are provided gratis with a nominal charge of 5 francs per month for service, and board at the common mess hall for 3 francs per day. Large amounts of reagents and glassware are charged at cost. The station has four microscopes, which may be furnished to investigators on application in advance to the director. Collecting, except for commercial purposes, is free. Everyone is free to work as he chooses and publish his results where he will, but the director offers the "Annales des Sciences Naturelles," of which he is editor, for suitable papers, and résumé of all published work is to be furnished for inclusion in the annual report. No printed rules are issued.

The station conducts a biological supply department, furnishing living animals and plants at cost of containers and shipping, and prepared material at cost of preparation. It is especially well situated for furnishing marine algæ and sends large amounts to educational institutions and investigators.

In addition to the individual researches of its staff the station conducts several lines of investigations; the first, because of its relation to the department of the marine, is a systematic attack upon the problem of hatching fish eggs and rearing the larvæ, especially those of the turbot, through the critical stage. For this purpose hatching devices of various types, storage tanks, and improved



PLAN OF BUILDINGS AND GROUNDS AT ST. VAAST-LA-HOUGUE.

By courtesy of Doctor Anthony.

breeding aquaria have been installed and various feeding methods tested with a view to bringing turbot hatching to a practical basis.

A second line of investigation followed systematically is that of anatomical researches upon the *Cetacea* and *Pinnipedia*. The extensive tidal flats and the extreme amplitude of the tides results in the frequent stranding of these marine mammals on the coast near the laboratory. The laboratory is accordingly equipped with photographic apparatus and special dissecting appliances for conducting these researches as opportunity offers. The work of the station in this field is supplemented by that of the museum at Paris, where anatomical models are made from the dissections for exhibition.

A third line of investigation is that of systematic plankton research carried on at regular intervals at the same locality near the station. The publications of specialists on these collections will be reissued in a special volume on the "Études sur le Plankton de la Baie de la Hougue." The station issues no other publications.

Saint-Vaast-de-la-Hougue is a fishing village on the eastern shore of the Manche Peninsula, about eight hours from Paris, reached by local train from Valognes, on the line to Cherbourg, or by steamer from Le Havre. The station is located on the Île Tatihou, opposite the village of Saint-Vaast-la-Hougue, in extensive grounds and numerous buildings originally used for hospital purposes. The island is a mile from the village, being separated from the mainland by the passage known as the "Rhun," and is accessible at low tide on foot or by carriage from the mainland, but the station maintains a ferry service for visitors, by previous arrangement, from the village quay, when tide permits, to the island with its motor boat, the *Tictac*.

The island contains about 27 hectares, of which a small part is included in the walled inclosure (200 m. square) of the station, which occupies its western part and controls a small part of the western coast with a small shelter harbor. The buildings are distributed upon a level prairie, at an elevation of 7 m. above high tide, and in comparison with most stations erected in narrow quarters at the seashore the station at Saint-Vaast is one of magnificent distances.

The establishment includes in all fourteen buildings, all but two of which, the hatchery and fish basins, are inclosed within the inner wall (Pls. XXVI and XXVII) in an area 83 by 57 m. The buildings for the most part belonged to the former hospital erected for French soldiers returning from Maximilian's Mexican campaign, but never used. They have been modified to meet the needs of a biological station and supplemented by new constructions for water supply and fish culture. The buildings include a long storehouse (8.5

by 46 m.), in which have been established a large, well-lighted "Salle des dragages," or sorting room (7.7 by 15 m.), with adjacent storeroom (3 by 7.7 m.), chemical laboratory (4.85 by 6 m.), glassware room (3 by 7.7 m.), dark room (2.75 by 3 m.), the remainder of the building being still used as warehouse for storage.

The main laboratory building (14 by 14 m.), with two stories and a mansard floor, contains on the ground floor the aquarium room (4 by 13 m.) and four laboratories, two of which (4.2 by 4.2 m. and 4.15 by 4.15 m.) are devoted to experimental fish culture—one provided with a Fabre-Domerge rotator and the other with a new apparatus devised by Doctor Anthony for hatching turbid eggs. There is also upon this floor the laboratory (4.15 by 9.2 m.) for micro-photography and one laboratory not specially appropriate (3.05 by 4.2 m.). A centrally located helicoidal granite staircase of remarkable construction leads to the upper stories—the second containing eight rooms, four (each 4.2 by 4.2 m.) of which are equipped for two persons, and three for one (each 3.05 by 4.2 m.), while the remaining room serves as an office of the assistant director. These rooms are intended to serve both as laboratories and bedrooms, and are provided with simple but sufficient furniture—a laboratory table, a sink with fresh water, a chemical table with lava top, and an aquarium sink table (1.1 by 1.1 m. or 0.8 by 0.8 m., with the corner cut back), with lead-lined tray 5 cm. deep, and salt-water supply. The four rooms upon the ground floor have a similar laboratory equipment. On the third floor are eight rooms of corresponding dimensions furnished as bedrooms only. The central hall on this floor contains the large iron fresh-water tanks supplying the laboratories.

In the same inclosure with the laboratory building is the engine house (6.3 by 8.3 m.), the water tower of granite masonry, with storeroom below (5 by 8 m.), and at the end of the lawn the lounging room, dining room, and kitchen, rendered necessary by the isolation of the station upon an otherwise unoccupied island. Close at hand is a stone structure of two stories, containing the residence and laboratory of the director. In the paddock to the north, at some distance from the other buildings, are two long one-story wooden buildings, each 8.5 by 24 m., originally intended as contagion wards for cholera patients returning from Mexico. The one to the east serves as a museum and is fitted with museum cases formerly at the Jardin des Plantes in Paris. The building to the west contains the library (8.5 by 9.25 m.) and a large room used for storage of nets, seines, and fishing gear, and is not as yet divided into laboratories, as shown on the plan (Pl. XXVI). Outside of the inner wall but within the outer inclosure is the underground reservoir and the fish-culture plant, consisting of two one-story

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wooden buildings, with thatch roof, a hatchery (7.5 by 7.5 m.), with Dannevig hatching apparatus and simple laboratory furniture, making it possible to use the room as an overflow laboratory, and a covered tank house (6.5 by 19 m.) containing three large tanks with masonry walls nearly a meter in thickness and a total capacity of about 300 cu. m. Turbot used in hatching experiments are stored in these tanks. The residence of M. Ch. Liot, the captain and machinist, and two houses for servants are also found upon the grounds.

The receiving rooms and the laboratory rooms are provided with stoves, grates, or oil heaters, and salt and fresh water are piped to all the laboratories, but there is no gas or electricity to be had on the island.

The equipment of the laboratory with glassware and chemicals for morphological work is quite ample. The station possesses five student microscopes of good grade, a Zeiss-Greenough binocular, a rocking and a Minot rotary microtome, paraffin oven, autoclave, Cogit bacteriological thermostat, centrifuge, precision balances, mercury pump, etc. There is also an excellent equipment for photographic work, including a camera for field work, a Zeiss apparatus, a stereoscope camera for microscopical work, and a suitable dark room.

The library of the station contains about 2,500 volumes, including complete or partial sets of many French serials and reports of expeditions, the Zoological Record, many monographs and papers. It is in regular receipt currently of a dozen periodicals. The library is catalogued and systematically arranged.

The collections are quite extensive, are well mounted and displayed, and fully labeled. They represent the local littoral and bottom fauna. The annelids, mollusks, hydroids, fishes, and water birds are well represented.

The herbarium contains about 800 sheets, largely representing the local marine algæ named by such eminent authorities as Shuret, Bornet, and Sauvageau.

The equipment for hydrographic work includes an assortment of areometers of Poulenc, Paquet, and of Thurneyssen, Richard reversing water bottle with Thurneyssen thermometer, an electric light and accumulator (Apparat Trouvé) for determining the transparency of the water, and a Thoulet bottom sampler.

The character of the marine equipment of the station is determined largely by the fact that the shoal waters of the neighborhood necessitate the use of boats of light draft and do not call for extensive apparatus for their exploration. In 1907 and 1909 the laboratory secured two new boats, the *Tictac*, a motor boat 10.8 m. in length,

2.8 m. in width, and 1 m. draft, and an 18-horsepower Forest & Gallis gasoline automobile engine, giving a speed of 8 knots. The boat has two masts and lateen sails, has a closed cabin forward of the engine, and cockpit which may be closed with canvas. She carries a crew of 2 and 20 passengers. A hand winch is provided for dredging or trawling. A second motor boat, the *Comatula*, (7 m. long, 2.1 m. wide, 0.65 m. draft) with an 8-horsepower motor, is used for lighter work. The station has a good assortment of shore collecting implements, dredges, trawls, fish traps, seines, and plankton nets of muslin and of silk.

The aquaria for storage and observation of living material are located in the aquarium room (4 by 13 m.) on the ground floor of the laboratory building. There are twelve tanks arranged against the outer walls of the room, unevenly and sometimes inadequately lighted by windows of customary location. The walls (25 cm.) and base (20 cm.) resting on brick piers are of granite, 0.8 m. high and 0.75 m. wide, and lengths of 1.2 to 1.4, 2, and 3 m., and the two corner basins with narrow (0.35 m.) oblique fronts. The panes set in the granite walls range in size from 0.8 by 0.35 m. to 0.8 by 1.8 m. and are 30 mm. thick.

Against the inner wall is a row of thirteen cement basins (50 by 50 cm. and 26 cm. deep) with cement partitions 8 cm. thick and plate-glass fronts 26 by 50 cm. and 1 cm. thick. These are used for smaller invertebrates and afford a variety of conditions of rock, sand, mud, *Zostera*, *Lithothamnion*, etc., and one is provided with an automatic tidal siphon. Through the center of the room is an aquarium table of granite 72 cm. high, 70 cm. wide, and 7 m. long, with overhead water supply 82 cm. above the table. The top of the table slopes to the center for drainage. In the sorting room (Salle des dragages) there are two handsomely finished aquaria for observational and photographic work, (Pl. XXVIII, A) made after the Roscoff pattern. They are mounted on slabs (10 cm. thick) of black and of white marble to afford suitable backgrounds for photographic work, and the table is about 20 cm. wide outside of the aquarium for notebooks or apparatus. The aquaria are 86 cm. long, 45 cm. wide, and 17 cm. deep, with plate-glass sides 6 mm. in thickness, held in place by corner posts of angle brass (2 by 2 cm. and 3 mm. thick), with a top band 2 cm. wide of T-shaped brass fastened to the top of the corner posts by L-shaped pieces of brass. The free angle of the T-band receives a carefully fitted plate-glass cover. A wooden cover is provided for keeping the aquaria in the dark when desired. These aquaria have tin-lined brass pipes in goose-neck form for overhead water supply and vertical standpipes with surface outflow.

A unique and satisfactory part of the equipment of the sorting room is a large U-shaped sorting table 1.06 m. wide, 0.8 m. high, a total width of 3 m., and a length of 6 m. (Pl. XXVIII, B). The top



A. OBSERVATION TABLES.



B. SORTING AQUARIUM TABLE.

After photographs by Doctor Anthony.

AQUARIUM ROOM AT ST. VAAST STATION.



is dished, forming a channel 16 cm. deep, and is lined with cement. This table serves for the leisurely sorting and washing of the contents of the dredge or trawl, as a large shallow aquarium or as a dissecting table for large animals.

The pumping plant housed in the machine room consists of a 3-horsepower Gnome petrol motor with a 5-horsepower B  nier hot-air motor in reserve. There are two double centrifugal pumps of Dumont type of bronze located 6 m. above level of the low-level reservoir and 8 m. below the high-level one. There is also a Baume-Vidal windmill, with a 5.8 m. wheel and a maximum force of 4 horsepower, specially geared, a 3-cylinder plunger pump of bronze. The windmill has proved to be very efficient in operation and often meets the pumping demands of the laboratory.

The water is drawn from a subterranean cement reservoir 2 m. below the surface (8 by 14 m. and 3 m. deep, with a capacity of 270 cu. m.), filled by a 20 cm. reinforced concrete conduit running 100 m. to a point on the beach. An automatic valve at the reservoir admits the water when the tide is 2 m. short of high tide and prevents its escape as the water falls. The level of the gate is such that at least 2 m. of water will always be retained by the reservoir. From the pump the water passes to the fish basins or to the high-level reservoir in the granite water tower, with a capacity of 30 cu. m., and is distributed thence in the open circulating system which supplies the aquaria, laboratories, sorting room, and, if need be, the hatchery and fish basins also. The mains (9 and 6.2 cm.) and laterals (3 cm., outside diameter) are of soft lead, with brass cocks and valves. The aquaria have overhead supply, delivering to the bottom of the aquaria through glass tubes with air inlet at the top. The outlets discharge surface water from the aquaria into floor channels beneath the tanks.

The experimental hatchery equipment includes Dannevig boxes (now discarded), and the apparatus of MacDonald, Chester, and Garstang, a Fabre-Domergue rotator with a one-fourth-horsepower Heinrich hot-air motor and a new apparatus on the principle of the Fabre-Domergue rotator (fig. 9), devised by Doctor Anthony (fig. 9). It consists of a barrel or drum of reinforced concrete (92 by 102 cm.) on a

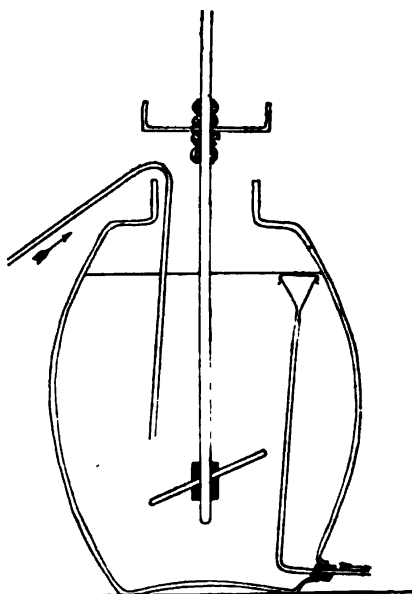


FIG. 9.—Anthony's turbot rearing tank, for the experimental hatching of the turbot.

stout stand with a dozen small plate-glass windows inserted at a convenient height for observation of the contents. Inside the drum is a rotator with disc 30 cm. in diameter driven by hot-air motor. Circulation is provided by a supply pipe discharging above the disc and a surface outflow pipe with funnel covered with gauze.

As annexes to the field resources the station controls a large oyster park between Tatihou and St. Vaast and the Ile de Terre, one of the Iles de St. Marcouf (area, 0.5 hectare), 7 miles southeast of the station. The shores of this rocky island form an admirable biological reservation for the growth and observation of the shore fauna under natural conditions.

The environmental conditions at St. Vaast present a rocky shore where granite rock strewn with bowlders affords attachment and shelter for an abundant flora and fauna. In the "Rhun" between the Ile de Tatihou and the mainland the loose rock is built into the walls of the numerous oyster parks. Elsewhere there is a great variety in shore conditions, rocks of granite, and schist, shingle, gravel, sand, and mud, with beds of *Zostera*, *Fucus*, *Laminaria*, and red seaweeds. The tides, which attain an extreme amplitude at spring of 11.4 m., expose a littoral zone often exceeding a kilometer in width of these varied environmental conditions. The fauna and flora are much like those of the littoral areas at Plymouth and Roscoff, with an abundance of attached and burrowing forms. The adjacent waters are shallow, a large territory being less than 10 m. in depth at low tide. Depths of 25 and 52 m. are to be found at distances of 2.5 and 10 miles, respectively. The bottom is sandy or of fine sand and mud with occasional banks of broken shells and rock.

The fauna and flora are predominantly neritic, and in their main features are like those at Roscoff and Plymouth, but with greater proportion of neritic elements.

The plankton is characterized by the large admixture of neritic species and larval stages. Résumés of the local fauna and flora with full bibliographies will be found in the papers of Fauvel (1905) and Corbière (1905), prepared for the meeting of the French Association for the Advancement of Science at Cherbourg, in a volume entitled "Cherbourg et le Cotentin."

Literature: Perrier (1888), Malard (1895, 1905), Sand (1897), Anthony (1907, 1908), Lefranc (1908).

**MARINE ZOOLOGICAL LABORATORY OF THE UNIVERSITY OF
CAEN, AT LUC-SUR-MER (CALVADOS).**

Director, Prof. Jean Joyeux, Laffuie, 70 Rue d'Assas, Paris.

Acting director, Prof. Emile Topsent, professeur du zoologie, Laboratoire Zoologique, Université de Caen.

Assistant, Dr. Charles Lebailly, Laboratoire Zoologique, Université Caen.

In addition a keeper and captain, a sailor-collector, and a laboratory servant.

Telegraph address: Laboratoire, Luc-sur-Mer (Calvados), France.

The station at Luc-sur-Mer is an annex to the University of Caen and is associated solely with the chair of zoology in that institution. The members of the staff of the department of zoology are also members of the staff of the station, receiving their appointment from the minister of public instruction. The station has no board of control, the director being responsible directly to the dean of the university.

The budget of the station is included in that of the zoological laboratory at Caen, and its entire staff, including the servants, receive their salary directly from the university budget and serve at the station without extra salary during the summer. The keeper alone is a permanent resident at Luc-sur-Mer. The station receives an annual grant of 2,500 francs for its upkeep. The salaries for service, amounting to about 1,700 francs annually, the upkeep of the library, and much of the equipment come directly from the university budget. The entire budget often supplemented by laboratory funds is used in the upkeep and improvement of the building and equipment at Luc-sur-Mer.

The station is used during the university year as headquarters for zoological excursions of classes from the university and is formally opened for instruction and research from July 1 to October 1 and may be temporarily opened at the Easter recess. Laboratory instruction is conducted by Doctor Lebailly during the summer season for qualified elementary students. The course consists of the informal study of marine types and of field excursions. An advanced course in histological technique for students beginning research is given three times a week in August by Professor Brazil of the University of Caen. The laboratory is also open to competent investigators. No fees are charged for the use of the laboratory; material for study and research, dissecting instruments, microscope, microtomes, paraffin ovens, reagents, chemicals, apparatus, and literature needed are supplied either from the laboratory or from the university at Caen. The use of the boats and collecting apparatus and of special aquaria can also be granted as a rule upon application. Collection of material for study, research, or museums is permitted, but the collector must provide his own containers and fluids.

Persons desiring admission should apply in advance to the acting director at Caen, stating the time for which the table is desired and whether or not lodgings at the station are wanted. Simply furnished chambers accommodating eight persons in all are provided in the station building, and their use is granted gratuitously to students and others, as far as feasible on application. A fee of 5 francs per month (or less) is paid for service.

Luc-sur-Mer is a popular summer bathing resort with numerous restaurants and small hotels in close proximity to the station, where suitable accommodations can usually be obtained.

The station conducts no biological supply department, bears no relation to the fisheries, has no formal programme of research, and issues no series of publications. The researches of its staff, published in the leading biological journals in France and elsewhere, deal mainly with sponges, parasitic protozoa, and cestodes.

Luc-sur-Mer is a seaside village on the south shore of the Baie de Seine, west of the mouth of the Orne, nearly midway between Le Havre and Cherbourg, reached in forty to sixty minutes from Caen (Gare de Saint-Martin) or in six to ten hours from Paris via the line to Cherbourg. The station is located near the eastern end of the marine promenade about five minutes walk from the railway station. It consists of a row of buildings fronting immediately upon the street along the beach, located in grounds containing about 750 sq. m. and separated by a street from the garden and residence of the director, belonging to the station.

The buildings are 20 m. from the sea wall and 3.5 m. above high tide. Fronting to the north upon the street along the beach are four connecting stone buildings, the aquarium building (7 by 16.5 m.) two stories in height containing the aquarium room on the ground floor and the director's laboratory (7 by 10.3 m.) and a large store room (6.2 by 7 m.) on the upper floor. A store room (6 by 9 m.) of one story with overhead passage way for fishing gear, etc., connects this building to the main laboratory, formerly a private residence but remodeled for laboratory purposes. It is a three-story structure (9 by 16.2 m.) containing upon the ground floor three rooms serving as student laboratories, each with windows to the north, furnished with simple work tables, fire-clay sinks with fresh and salt water, an aquarium, dissecting tables (62 by 115 cm.) with glass tops formed of heavy panes of ribbed (beneath) glass set in cement, with rim on three sides and sloping to one corner with outlet for waste water. These rooms (3.7 by 4.4, 4 by 7, and 3.6 by 7 m.) have, facing the north, windows for eight students, but additional tables can be added. The central room contains a well-mounted and fully labeled collection of invertebrates and fishes representing the local fauna displayed in glazed wall cases. Upon this floor is a work shop (4.3 by 4.4 m.) with tool bench and water still.

On the second floor, the center of the building is occupied by the research laboratory (6 by 7 m.), with three places equipped with tables facing north windows and an abundance of accessory table space, fire-clay sink with fresh and salt water, glass-topped aquarium table, etc. A library of about 2,000 volumes of biological serials and monographs drawn from the university is kept permanently in this room. Upon either side of the room and upon the floor above are chambers, six in all, with accommodations for eight persons.

Two of these rooms are equipped with tables for microscopical work. The station has thus in all places for fourteen workers.

On the south side of the laboratory and connected with it is the engine room (2 by 2.8 m.) and water tower (4.3 m. in diameter and 7 m. high) with dark room fitted for photographic work beneath.

Adjacent is the acetylene house (1.5 by 2.15 m.) with the system "Le Claireur" for supplying gas to the station for light and laboratory use and the keeper's lodge of three rooms.

The pumping plant consists of a "Le Progrès" petrol motor of about 3 horsepower and brass pump with horizontal plunger. The sea pipe is a 6 cm. lead pipe passing to a point on the beach above low tide about 75 m. from the pump, where it opens in a cement block to which it is anchored. The water is carried by a 6 cm. lead main to the masonry reservoir (3 m. diameter and 2.5 m. in height with walls 0.3 m. thick) with a capacity of 11 cubic meters. The distributing system consists of lead pipes with mains 6 cm., laterals 3.2, and terminals 1.5 cm. in diameter. The cocks and valves are of brass.

The aquarium room, to which without charge the public is occasionally admitted, contains eight separate open aquaria on slate slabs resting on brick pillars (0.9 m. in height). The bases of the aquaria are formed by these slabs (2.5 to 4 cm. thick) in which are grooves (16 mm. wide and 20 deep) to receive the glass and the corner posts of angle brass (3 by 3 cm. and 2 mm. thick). The sides are of plate glass (8 mm. in thickness, set in ordinary Portland cement). The dimensions (in centimeters) used are as follows:

Dimensions of aquaria.

Length.	Width.	Height.
24	56	102
30	56	102
18	56	82
24	40	82
38	95	95

The aquaria are supplied by overhead spray delivered from an oblique glass pipette at a height of 20 to 30 cm. above the water level. The overflow is carried off from the surface by vertical glass tubes set in corks in the corner of the aquaria, discharging into 3 cm. lead pipes beneath, which in turn discharge in open channels in the stone floor. The water passes but once through the circulating system.

In this room are two floor tanks (2 by 2.3 and 2 by 3.7 m. and 45 cm. deep with walls 13 cm. thick) of brick, lined throughout with glass set in cement. The glass used is in panes 25 cm. square, ribbed beneath, and is of the sort employed in the lining of wine vats in France. These tanks are used as aquaria for fish and large inverte-

brates. They are supplied with overhead spray at a height of 0.9 m. and their outflow is from the bottom or surface and is regulated by an ingenious device with adjustable valve, as shown in the accompanying figure.

The perforated lead bulb is placed on the lower arm of the inner lead pipe for bottom outflow and on the upper for surface outflow, the orifice not in use being stopped with a cork.

The aquarium room is also provided with large dissecting table (0.8 by 2 m. and 1 m. high), of stone, concaved toward the middle, with drain pipe and overhead water supply.

The Luc-sur-Mer laboratory has an ample equipment of glassware and chemicals and draws its supply of instruments, etc., from the laboratories at Caen. Its field equipment consists of a yawl,

the *Nauplius*, 7 m. long, and a rowboat with the usual outfit of dredges and seines. It has several 4.5 m. beam trawls, traps, and crab pots, plankton nets, etc., and considerable assortment of implements for shore collecting.

There is no harbor at the station, the nearest shelter in time of storm being found at Ouistreham, 6 km. distant. The beach at Luc-sur-Mer is sandy, with some pebbles and shingle, and wide stretches exposed at low tides with occasional

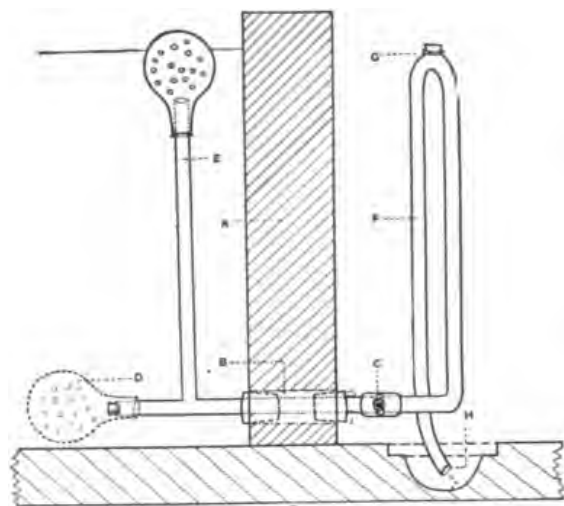


FIG. 10.—Siphoning device for floor aquaria at Luc-sur-Mer, shown in section: a, wall of aquarium; b, cana through wall; c, cock; d, perforated lead bulb (removable); e, standpipe for surface overflow; f, siphon; g, air valve, with screw; h, outlet into floor channel.

patches of green algæ. The bottom in adjacent waters is sandy, with considerable areas of broken shells and mud and occasional rocky regions, affording fine trawling ground. The water is shallow, attaining a depth of 40 meters only at a distance of about 40 km., and the greatest depth available in the English channel opposite, near the station, is only 78 m.

Literature: Sand (1897).

ZOOLOGICAL STATION OF PORTEL.

Director, Prof. Paul Hallez, Laboratoire de l'Anatomie et de l'Embryologie Comparé. Rue Brûle-Maison, Lille, France. August-September, station Zoologique, Le Portel près Boulogne, Pas-de-Calais.

In addition one porter and collector.

In 1888, upon the transfer of Prof. A. Giard from the University of Lille to the Sorbonne at Paris, the station at Wimereux, which for fifteen years had been associated with the former university, was taken with its director into relations with the Sorbonne. Called to the chair at Lille, Prof. Paul Hallez set about establishing a station for the instruction of the pupils of the university in marine zoology, and selected a location at Portel about 2 km. south of Boulogne-sur-Mer upon the other side of the port from Wimereux, not far from the private marine laboratory of M. Bettencourt. (See Giard, 1889.) Here, on May 1, 1888, the station was opened in a rented cottage. In 1890 the facilities of the station were increased by the purchase of the *Beroe*, and in 1895, by agreement between the ministers of public instruction and public works, a site was secured for the station near the base of the great Carnot mole forming the outer shelter harbor at Boulogne. Finally, in 1900, the University of Lille voted the funds necessary for the construction of the building, and grants from the ministry of public instruction, the Society of Sciences of Lille, and the French Association, provided for the furnishing and equipment of the building. Research tables were founded by Profs. Ch. Barrois, E. Vaillant, and M. Lonqu  ty.

The station is attached directly to the University of Lille and is used primarily for the instruction of university students at the Easter and summer vacations and for the researches of the staffs of the departments of comparative anatomy and embryology and zoology. It is fitted accordingly for instruction in marine zoology. Research is, however, prosecuted actively at the station, over one hundred papers having been prepared in whole or in part by its aid, appearing in various biological periodicals of France and elsewhere. It issues no publications and carries on no established programme of exploration or investigation.

Its privileges are afforded without charge to all qualified students and investigators on application to the director, in so far as room permits. Material or the means of securing it are supplied and also the ordinary chemicals and glassware. Investigators should provide their own microscopes, however. Biological material for instruction or research is supplied at cost by arrangement with the director, but no regular supply department is maintained. A few furnished rooms are available at a nominal fee to the concierge of 2½ francs per week.

The station does not maintain any connection with the fisheries, but receives meager support directly through the university. It receives in addition much gratuitous service, and assistance from private funds enables it to carry on its work. Its annual expenditures are 3,000 to 4,000 francs.

The station is open in the Easter recess and in the summer vacation from June 15. It is attended annually by about twenty-five

students and five investigators. Its clientele is drawn not only from the University of Lille, but also from Belgium, Germany, and Switzerland.

The station is located at the eastern end of the village Le Portel, about 2 km. southwest of the entrance to the port of Boulogne-sur-Mer, immediately at the base of the great Carnot dike, which extends seaward for 2,150 m., forming a sheltering wall for the Port Nouveau. It lies close to the Petit Port upon a filled level area at the foot of the cliffs. It is reached from the village of Portel, where a conveniently located hotel is found, or by carriage from Boulogne via the Boulevard Chatillon to the water front.

The building (Pl. XXIX, A) stands a few meters from the water's edge in inclosed grounds containing 2,140 sq. m., about 3 m. above ordinary high tide. It is a plain rectangular structure (11 by 31 m.) of brick and plaster of two stories with tile roof. Its long axis runs northwest by southeast, and it is abundantly lighted by numerous windows. Projecting from the building from the landward side is the one-story aquarium room, with cement water tank above.

The ground floor (Pl. XXIX, B) has its main entrance on the long façade leading into a cruciform corridor, from which ascend the stairs to the second story. At one end the main corridor opens into a general student's laboratory (5 by 11 m.), lighted on three sides and providing places for eight or more students. At the other end of the hall is the large aquarium room (11 by 11 m.). Opening from the hall are a reagent room (2.5 by 4.5 m.) and private laboratories. One of the larger rooms serves as the director's office and laboratory. Upon the second floor are the modest quarters of the director and ten chambers simply furnished as lodgings for students.

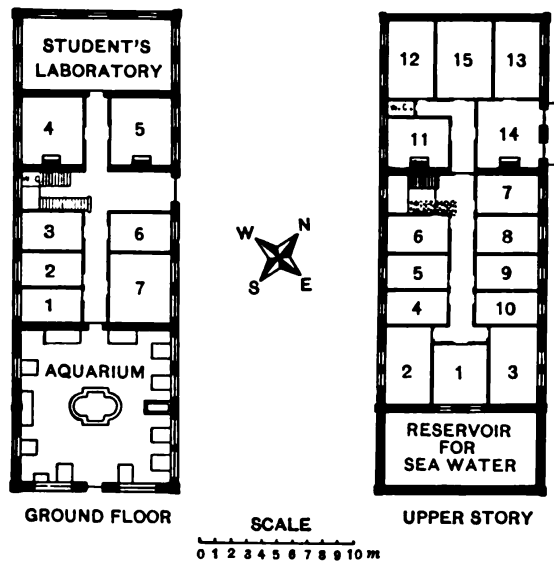
Adjacent to the station is the two-story building (5 by 13 m.) containing the quarters of the keeper, storeroom (5 by 7 m.), and machine room (4 by 5 m.).

The general laboratory and research rooms are provided with fresh and salt water, are lighted by oil lamps, and two of them are heated by grates. They are simply furnished with wall tables, book and reagent cases, and shelving. The equipment for research and instruction is drawn from the laboratories at Lille. No museum or library is maintained at Portel.

The pumping plant consists of a 3-horsepower Crossley engine, with a centrifugal iron pump with lead lining. The water is drawn through an 8 cm. cast-iron sea pipe, 50 m. long, opening directly on the sea wall 2 m. below high tide. After flushing the sea pipe and pump, the water is pumped into a settling basin (4 by 6 m.) containing 60 cu. m., adjacent to the machine room. Thence it is pumped to the cement reservoir above the aquarium room (5 by 10 by 1 m.), containing 50 cu. m. This reservoir is roofed over with cement and supplies the aquaria and laboratories below. The mains are of 8 cm.



A. STATION BUILDING.



B. FLOOR PLANS OF STATION, AFTER HALLEZ (1909).
ZOOLOGICAL STATION AT LA PORTEL.



A. AQUARIUM ROOM, SHOWING FLOOR TANK AND AQUARIA TABLES.



B. AQUARIUM TABLE WITH THREE GLASS BASINS.
AQUARIA AT LA PORTEL STATION.

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cast-iron pipe. The distributing system is of soft lead (5 and 2 cm.), with brass cocks. The terminals are of rubber tubing, with pinch cock and glass tips. The aquaria are provided with overhead spray and vertical standpipe, with surface run-off through inverted perforated cones of porcelain.

The aquarium room (Pl XXX, A) is abundantly lighted, the light being softened by paint upon the glass. It has a central floor tank in the form of a coupéd cross, with two ends rounded. Its extreme dimensions are 2.6 by 3.7 m. by 35 cm. deep, with central fountain and vertical standpipe for outlet at one side.

About the periphery of the room are eleven aquarium tables of reinforced concrete (Pl. XXX, A), with tops 1 by 1.25 m. and 12 cm. thick and 0.9 m. from the floor. In the center of each is a fixed plate-glass aquarium (0.6 by 0.9 m., with sides 0.2 or 0.3 m. high), with the glass set in grooves in the cement top and in slotted bronze angle posts (2 by 2 cm.) at the corners. The glass is 4 and 8 mm. in thickness and is set in minium cement. In addition there are three tables (0.9 by 2.25 m. and 5.5 cm. thick) of reinforced concrete for movable glass aquaria (Pl XXX, B). There are three glass tanks (42 by 60 cm. and 18 cm. deep), with outlets let through the corners. There is also a cement sorting tank (0.9 by 1.7 m. and 1.05 m. high) in the form of a cement tray, with sloping bottom, 20 cm. deep at one end and 7.5 at the other. The aquaria are all independent, and the water is used but once.

This aquarium room is a model for excellent illumination and arrangement, ease of access and observation, durability and simplicity of construction of the aquaria.

The natural conditions are not unlike those at Wimereux in the main. The great stone pier extending for over a mile seaward furnishes a rocky collecting ground, easily accessible at all times, of great extent, upon which a varied shore fauna finds attachment and shelter. Excellent and varied dredging grounds lie close at hand.

Full accounts of the fauna upon the dredging grounds will be found in the papers of Professor Hallez (1899) and complete lists of several groups in his special summaries of the anemones (1890), nemertines, turbellarians, and a bibliography of other groups, with later additions in his faunistic notes.

Literature: Hallez (1890, 1899, 1909).

STATION AQUICOLE, BOULOGNE-SUR-MER, FRANCE.

Director, Dr. A. Cligny, station Aquicole, Boulogne-sur-Mer.

Telegraph address: Station Aquicole.

In addition, one keeper, one skipper, two engineers, and three sailors.

The decline of the fisheries on the northern coasts of France and the need of scientific assistance in solving many of the problems pressing

for solution led M. A. Huguet, senator of Pas-de Calais and mayor of Boulogne, to urge in 1881-82 upon a committee of the French Senate appointed to investigate the fisheries the establishment at this important fishing port of a fisheries research station. The movement finally resulted in government grants for the enterprise and its affiliation with the central fisheries bureau at Paris.

The rapid development in recent years of the fishing industries at Boulogne, and the extension not only to the Faroes, Iceland, and Newfoundland, but also to the coasts of Africa, have made this city the foremost fishing port upon the Continent. The station has taken an important part in this progress by its investigations into the methods of fishing used elsewhere and into the technical matters of cold storage, and has recently greatly extended its facilities and projects for the technical instruction of skippers and engineers for the fishing fleet.

The station was founded in 1884, with Dr. E. Sauvage, assistant in ichthyology at the Museum of Natural History in Paris, as director, and remained under his direction for a decade. In 1892 Dr. J. Canu became assistant at the station, and in 1894 was made its director, retaining the post till 1902. In 1900 Dr. A. Cligny, of the Paris Museum, was made assistant at the station and in 1903 succeeded Doctor Canu upon his retirement.

Its object has been from the first the investigation of the immediate practical problems of the fisheries rather than any general programme of biological investigations. It is not connected with higher institutions of learning and only indirectly serves the cause of scientific instruction and research by providing field excursions and occasional collecting trips on its boats for students and investigators at the neighboring stations of Wimereux and Portel.

It has, however, close affiliations with the local technical schools, the "École pratique d'Industrie" and the "École d'Hydrographie," adjacent to the station. It provides upon its boats practical instruction each year for some seventy lads from the training school, who are preparing to become marine engineers and firemen. The "École d'Hydrographie," established in 1909, is designed to train men as skippers for fishing and commercial boats. Instruction in practical navigation, the manipulation and management of fishing gear, and in the practical and technical phases of salting, curing, cold storage, and marketing of fish is given in this school, and the facilities of the station will form a part of its equipment, while its boats are used in its field work.

The director is an attaché of the Service Scientifique des Pêches Maritimes, in charge of the district from Calais to Brest, and the station is located in the "Laboratoire départemental du Chimie, agricole et industrielle de Boulogne-sur-Mer." The station is sup-

ported entirely from state funds, receiving an annual grant from the ministry of agriculture of 2,000 francs and from the ministry of the marine of 3,500 francs for upkeep. In addition there are allotments for salaries to the amount of 7,600 francs and for the upkeep of the boats of the station of 16,000 francs per annum. Of the latter sum 7,500 francs is paid for wages, 3,000 francs for coal, and the balance for equipment and repairs.

The station has supervision of the coast fisheries and the oyster parks, especially in the matter of sewage pollution on the north coast of France, and conducts special investigations on fishery problems, as, for example, on the effect of shrimp fishing at different seasons of the year, upon the supply of young fish, and on the methods and results of cold storage as applied to the sea fisheries. It also carries on some investigations on the plankton and on the development of the food fishes. It offers no facilities for research to outsiders. The results of its investigations are published in the *Annales de la Station Aquicole* (vols. 1-2, 1892-1894, N. S. V.; 1-2, 1905-1909), issued at the expense of the director.

The station is located on Boulevard Chatillon, a few minutes' ride by tram from the central railway station in the "Laboratoire départemental de Chimie," adjacent to the new port. It occupies five rooms on the second floor of this building for its office, laboratory, and collections, and several rooms on the ground floor for stores and its fresh-water fish hatchery. It is not supplied with salt water and contains no aquaria other than those used in the hatchery. The collection contains a full representation of the fishes of the channel and many invertebrates and a collection of charts illustrating statistics of French fisheries, especially those of Boulogne for many years past. The station possesses a simple laboratory equipment for fisheries work and a small hatchery for rearing the fry of *Salmonidæ*. It has also a Fabre-Domergue rotator for sea-fish eggs, but does no sea-fish hatching.

The station has a fishing steamer (see Cligny, 1909), *La Manche*, built in 1907 especially for the purposes of technical instruction and research. She is a stout wooden steamer of 96.76 gross tonnage, built on the lines and with the rigging of the Boulogne herring boats, with a length of 26 m., beam amidships of 6 m., and draft astern of 3.1 m. She has two masts, with full equipment of sails, and a compound condensing engine of 147 horsepower, and can make 8.5 knots per hour. Her bunkers carry 18 tons of coal, sufficient for eight days' steaming at full speed. She carries a crew consisting of one captain, two engineers, and three sailors, with supplementary aid from the pupils of the fisheries school. To provide for these pupils her engine room is unusually large, and bunk room forward is provided for fifteen boys. The boys, 15 to 18 years of age, are taken from the school in lots of

fifteen and are given practical instruction at sea in short cruises of two or more days.

The boat has aft of the large forecastle a fish hold the width of the ship, 2.35 m. in length, large enough to receive 100 barrels of fish. Amidships and also extending across the ship is the live well or vivier 3.8 m. long, with a surface of 20 sq. m. and a capacity of about 11 cu. m. The well communicates with the sea, and the circulation is insured by connecting the pump of the condenser with the well, giving a circulation of about 20 cu. m. per hour. Planking above the water level affords access for examination of the contents of the well and also serves to reduce the swash of the water in a heavy sea.

Above the live well and upon either side of its opening are two compartments (1.9 by 3.8 m.) communicating forward of the live-well hatch, which serve as laboratories for the scientific work. The light through a side port is insufficient for many kinds of laboratory work.

The engine room (7 m. in length) is separated from the live well by water-tight partition and double air spaces, with special protection against the transmission of heat. Aft of the engine room is the cabin for the skipper, instructor, and engineers, and that of the director. The boat is specially planned to conform as nearly as possible to the type of the small steam trawler, in order to familiarize the pupils as far as possible with the boat, machinery, and gear used by Boulogne fishermen.

The boat is equipped with a 6-horsepower steam winch and two lengths of galvanized steel cable one-half inch in diameter and 120 fathoms in length for trawling, and 100 fathoms of 4 mm. cable for hydrographic and plankton work.

She carries commercial otter trawls and drift nets, two half-size Petersen young-fish trawls, two reversing thermometers, a Nansen-Pettersson insulated water bottle, and silk plankton nets of Hensen and Cépède models. The station has also a motor boat (5 by 1 m.), the *Orthonecte*, with 7-horsepower Aster benzine motor.

Literature: Huguet (1882), Cligny (1909)

ZOOLOGICAL STATION OF WIMEREUX, WIMEREUX (PAS-DE-CALAIS).

Director, Prof. Maurice Caullery, Laboratoire d'Évolution des Êtres Organisés, 5 Rue d'Ulm, Paris, professor adjoint à la Sorbonne, Paris.

Préparateur, Dr. Casimir Cépède, Station Zoologique, Wimereux.

In addition, one keeper and laboratory servant.

Telegraph address: Station Zoologique, Wimereux.

The Wimereux station is a fitting memorial of Prof. Alfred Giard, its founder and director for thirty-four years, an inspiring teacher, an enthusiastic naturalist, and an investigator of wide interests and deep insight into the fundamental evolutionary significance of the problems of biology. Called in 1873 to the chair of natural sciences

at the university at Lille, he established in the following summer a seaside laboratory for himself and his pupils at the most convenient point upon the neighboring coast, Wimereux near Boulogne-sur-Mer. For twenty-five years this station was maintained in a rented cottage located at the western side of the now filled in and ruined harbor of Wimereux excavated in 1803 by Napoleon. At the Easter recess and in the longer summer vacation Professor Giard and a small group of eager students were always found here hard at work in the intimate association of master and pupil which the cramped quarters and meager facilities of the enterprise necessitated. But there were compensations, for the stimulus of this close association made the Wimereux station one of the most productive centers in France and, as at that time there gathered at Marseille in the little laboratory of Marion a group of investigators and students imbued with Darwinistic ideas, so at Wimereux, about Giard, the devotees of the new ideas sought to interpret the facts of morphology and development in the light of the evolutionary principles. It was a period of great productivity, to which the pages of the "Bulletin scientifique de la France et de la Belgique" of which Giard was editor, bear witness. In 1887 the director was called to the École normale supérieure in Paris, and in 1889 to the Sorbonne to the chair d'Évolution des êtres organisés, and the laboratory at Wimereux became an annex of the University of Paris attached to that chair.

In 1890, by decree, the abandoned tower of Ambleteuse, Fort Mahon, was turned over to the minister of public instruction for the use of the laboratory, but could not be utilized in the absence of funds considered necessary for repairs and rebuilding the plant for protection against the inroads of the sea and for laboratory purposes. Fortunately a public-spirited friend of the laboratory, M. Lonquéty of Boulogne, came to the rescue and upon the occasion of the meeting of the French Association at Boulogne in 1899 offered to build and furnish a laboratory and cede it to the Sorbonne in return for the dismantled fort. This gift of 72,000 francs, disguised in the form of an exchange, equipped the institution with a picturesque though ill-adapted building containing laboratory, aquarium room, lodgings, and director's residence, and a further gift from the same source in 1908 of 10,000 francs provided for the erection of a part of the wing designed for the collections.

Upon the death of Professor Giard in 1908 the directorship of the station passed to the hands of his pupil and successor, Prof. Maurice Caullery, the present director.

The station at Wimereux is directly attached to the chair d'Évolution des êtres organisés, of the Sorbonne, and the director and staff are appointed in the manner usual in the University of Paris. There is no board of administration, the organization being simple and the

responsibility direct. The director is usually resident at the station in vacation seasons and the preparator is in continuous residence.

The staff is paid by the university and receives no special salary for its relation to the station. The station receives an annual grant of 6,000 francs in the university budget. Of this 1,200 francs are paid for service and 4,800 francs for upkeep of the building and grounds and for equipment. The publications are the private property of the editors or authors and are not an expense to the station.

The Wimereux station is an institution of higher instruction and research. Student excursions go to the station for the Easter vacation, and advanced students and investigators throng to it in the summer vacation during which advanced instruction adapted to the available material and to the needs of the individual student is given. It is open throughout the year to properly qualified investigators upon application to the director at Paris. No fees are charged, workers are provided with a laboratory table, with the necessary glassware and reagents, and the implements for collection of material. Microscopes and physiological apparatus are not furnished and expensive reagents or large quantities of reagents or containers are supplied at cost.

The laboratory has seven furnished chambers which are placed at the disposal of investigators at a charge of 10 francs per month or 2.50 francs per week. A comfortable hotel and a restaurant close by the laboratory and abundant tourist accommodations in the adjacent towns of Ambleteuse and Wimereux are offered.

On account of climatic conditions the winter months are unfavorable for field work at Wimereux. The station is usually full from July to October and at the Easter recess. It is frequented especially by French and Belgian students and investigators but guests from other European countries are not infrequent. Half-fare rates on the railroad to Wimereux or Boulogne-sur-Mer are granted to persons going to the laboratory on advance application to the director at Paris.

Investigators are free to work in whatever field they choose and to publish their results as they will. By special arrangement with the director papers may appear in the "Bulletin scientifique de la France et de la Belgique" or in the "Travaux de la Station Zoologique de Wimereux." The latter series contains more extensive monographs published at the author's expense. No special biological supply department is maintained at Wimereux, but collecting for research and instruction is freely permitted.

The station has no obligatory relation to the fisheries but by special arrangement may undertake the investigation of special problems. Cordial relations exist between it and the Station Aquicole at Boulogne-sur-Mer and naturalists often utilize the field trips of the

steamer at the Boulogne station for their collections. The station has no special programme of investigation. Many important investigations of morphological, embryological or monographic character have been carried on with its aid. At present the assistant naturalist, M. Cépède, is conducting seasonal observations upon the plankton, especially the phytoplankton.

Coincidentally with the foundation of the station, Professor Giard undertook the editorship of the "Bulletin Scientifique de la France et de la Belgique" (vol. 42 in 1909), and much of the work done here has appeared in its pages. Upon his death it passed to the editorship and ownership of a board of editors, including the present director, Professor Caullery, and other pupils and friends of Professor Giard and the Wimereux station. An independent series, "Travaux de la Station Zoologique de Wimereux" (including originally those of the "Institut Zoologique de Lille), contains the more extensive or monographic papers issued at irregular intervals, No. 8 appearing in 1900.

Wimereux is a small seaside resort between Boulogne and Calais, reached in three to four hours from Paris or four to five hours from London. It is 6 km. north of Boulogne, with which it is connected by both rail and tramway. The station is located at the edge of the dunes, 2 km. beyond Wimereux. From the terminus of the Boulogne-Wimereux tramway an automobile service (train Renard) is operated several times daily to Ambleteuse and Wimille, passing the station.

The station stands at the sea front about 100 m. from the boulevard to Ambleteuse in rectangular grounds containing 2,500 sq. m. Its elevation above high tide is about 8 m. and the building stands about 12 m. from the concrete sea wall built to protect it from disastrous erosion by the sea, which is encroaching upon the cliffs in the locality. The building, designed by the government architect, M. Louis Bonnier, after plans by Professor Giard, is an effective piece of architecture, with gables, chimneys, and tower of gray stone and red tile roof. The plan of the building in its entirety contemplates a U-shaped structure, with central garden open to the east between the wings. The north wing, with its long axis running east and west, is the main laboratory building, three stories in height, with included water tower. Joined to this on the base of the U next the sea front are two connected but independent dwellings, one (4 by 8 m.) of two stories, with shop (*At.*, 4 by 5 m.) and storeroom (*R.*, 3 by 4 m.) below (fig. 11) and the three rooms of the keeper's quarters (*L. G.*, fig. 12) above; the second is the director's residence, of irregular outline and extreme dimensions of 8 by 10 m., with cellars on the ground floor (*T.*, fig. 11) and five modest rooms (*L. D.*) in the two stories above.

The other arm of the U was partially constructed in 1908, the terminal portion (4.5 by 10 m.) being erected as a beginning of the

museum. This contains four small rooms and the stair and will be used for the display of the Bettencourt collections.

The main laboratory building (10 by 19 m.) (Pl. XXXI, A, figs 11 and 12), with the thick-walled water tower (*P.* and *N.*, 3 by 5 m.) set partially into it in the angle between it and the keeper's lodge forms an independent building. In the base of the water tower is a machine room (*N.*, 2.8 by 3.3 m.) connected with the shop. Above it in the second story is the dark room (fig. 12, *P.*), entered from the chemical laboratory, while on the third floor is the reservoir, with terrace and flagstaff above it.

The ground floor (fig. 11) is entered from the garden by a centrally located vestibule (*V.*, 4 by 4 m.), with stair to the rooms above

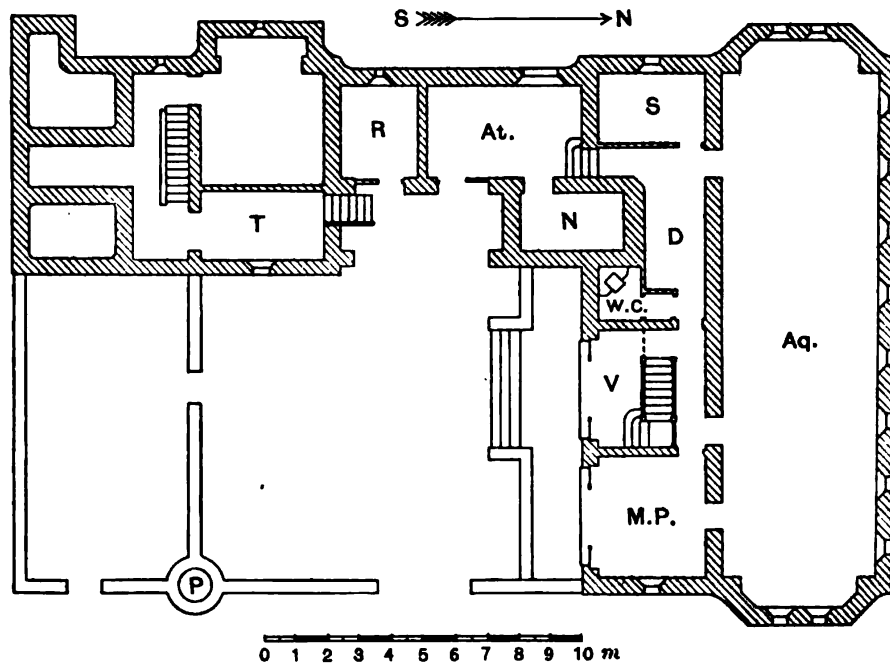


FIG. 11.—Basement floor, zoological station at Wimereux.

Above the door is the legend "Université de Paris, Faculté des Sciences, Station Zoologique." The corridor storeroom (*D.*, 2 by 4.5 m.) leads to the dressing room (*S.*, 2.3 by 3.5 m.), with lockers and shower bath, a useful adjunct after collecting trips on the beach or the popular diversion of an afternoon dip in the surf. A large tackle room (*M.P.*, 4 by 4 m.) opens directly upon the terrace of the garden. The main part of this floor is occupied by the aquarium room (*A.*, 6 by 19 m.), lighted by numerous small windows set high in the walls.

The second story (fig. 12) contains the main laboratory (*A.*, 6 by 19 m.), lighted by double windows at the ends and a row of eight on the north face, each a meter in width, with large panes. Across the two ends and in front of the windows is a shelf table (53 or 73 cm. wide).

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A. STATION BUILDING FROM THE EAST.



B. INTERIOR OF GENERAL LABORATORY.

ZOOLOGICAL STATION AT WIMEREUX.

From this there project into the room at regular intervals short tables (55 by 84 cm.), with open shelving above running at right angles to the wall and thus forming eight open cubicals (Pl. XXXI, *B*). These are models of compactness, the floor space allotted to each being about 2.2 sq. m., with at the same time abundant table space and ample shelving within easy reach of the worker. Through the center of the room are two racks for aquaria and glassware, each 6.1 m. long and 1.65 m. in height, with shelves 40 cm. wide, one of which is covered with sheet lead. The two uppermost shelves have slat tops to permit drainage. The highest shelf is but 32 cm. in width. Against the rear wall are a large fireplace, an upholstered settee, large banks of shelving for glassware, etc., and glazed sinks with fresh and salt water in the corners of the room. The glazed tile floor, light walls, abundant

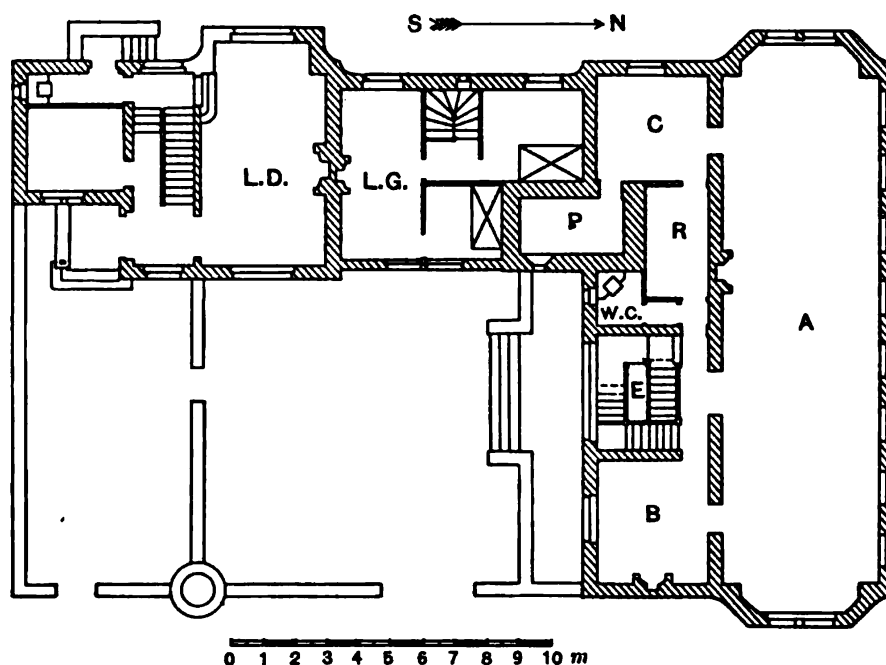


FIG. 12.—First floor, zoological station at Wimereux; after Menegaux (1905).

windows, and neatly finished woodwork give this laboratory a cheerful and bright appearance. The fittings are all made up by bolting the parts together to avoid damage by water and also to facilitate repairs or changes. Adjacent to the main laboratory are the chemical experimental room, (fig. 12, 3.2 by 3.7 m.), the reagent and glassware storeroom (*R*, 2 by 3.5 m.) and library (*B*, 3.7 by 4 m.), with glazed cases, chests of drawers, and reading table. A bust of Charles Darwin stands in the alcove above the hearth.

In the third story are seven chambers simply furnished for the lodging of workers at the laboratory. They may also be used as laboratories, affording window space for eight workers. The laboratory will thus accommodate in all a score of students or investigators.

The main laboratory and several of the chambers are provided with grates for heating. The building is lighted by oil lamps and is piped for fresh water from the cisterns of the laboratory. The salt-water circulation is not as yet installed.

The laboratory is well supplied with glassware and reagents, is provided with a Gram rocking and Minot rotary microtome, paraffin ovens, a Zeiss-Greenough microscope, Zeiss apochromatic and a Stiasny microscope. The library contains about 300 volumes of selected works, general treatises, monographs, and papers bearing on the local fauna and flora, and may be supplemented on demand by books from the library of the Laboratory of Evolution at Paris. The collections illustrating the fauna and flora of Boulogne and vicinity are most excellent and are fully labeled in most cases. They include the extensive collections made by Doctor Bettencourt, who for a number of years maintained at his own expense a marine research laboratory at Portel (see Giard, 1889) and made large collections along the coast, especially of hydroids, sponges, and bryozoans. There is also a collection of mollusks (marine, fresh water, and terrestrial), of algæ, and of mushrooms. The fauna and flora of the adjacent dunes and of brackish and fresh waters are also represented as a result of the labors of the founder of the station.

The station has as yet no pumping plant or salt water circulating system, all salt water for use in the aquaria and laboratories being brought into the laboratory by hand. The aquarium room is, however, fitted with two banks of aquaria built of concrete in the form of a series of arches supporting a row of tanks above and containing beneath each arch a floor basin. The banks are 5 m. long and 0.5 wide and 1.45 and 1.65 m. in height at the ends, and each supports a series of six of decreasing length and height. The aquaria are all 0.5 m. wide and measure in length and height, respectively, 93 by 45, 77 by 37, 77 by 34, 73 by 31, 68 by 28, and 60 by 24 cm. and have plate glass sides 6 mm. thick. Beneath each arch is a cement floor tank (0.5 by 1.15 and 0.4 m. deep). Both aquarium and floor tanks are provided with removable covers of glass or wire netting. At the ends of the room are two large cement floor tanks, one of semicircular form (2.5 by 2 m. and 1 m. high), with dish-shaped bottom; the other 2 by 2.2 m. and 0.8 m. high, with walls 25 cm. thick, lined with opal glass. Through the middle of the room are two long aquarium tables (0.8 by 3.7 and 0.9 m. high) of bolted woodwork, with top containing two rows of open slatwork made of oak pieces 3 by 3 by 25 cm., set in the planking margin and axis. The room is provided with glass jars and boxes for aquaria and with Coste fish-hatching troughs of yellow crockery ware.

Owing to the absence of a harbor at the station, only such boats can be kept as can be beached. The station has at present only a

stout sailboat 3.5 m. long. The field equipment consists of small dredges, trawls, and plankton nets and an excellent outfit of bars, hooks, nets, and spades especially made for shore collecting among rocks, tide pools, and on sandy beaches.

The environmental conditions at Wimereux are not unlike those at Luc-sur-Mer and Portel. The great amplitude of the tides, attaining 11 m. at spring, exposes wide stretches of the shore. Adjacent to the station a rocky reef, with zones of *Enteromorpha*, *Fucus*, and *Laminaria* and numerous tide pools afford a superb collecting ground for the littoral fauna. Wide flats of sand and shingle are also available, and mud flats are found at Boulogne. A small stream, the Ruisseau des Oiës, near the station, provides convenient access to the fauna of brackish and fresh water. A very full account of the local fauna will be found in the papers of Giard (1899, 1899a).

Literature: Giard (1889, 1899, 1899a), Menegaux (1905), and Caullery (1907, 1908).

BIOLOGICAL STATION OF AMBLETEUSE (PAS-DE-CALAIS).

Director, Prof. Charles Maurice, Laboratoire de Zoologie, Université Catholique de Lille, Lille, France. Ambleteuse, Attiches, par Port à Marcq (Nord). At Ambleteuse, August-September.

Chef-des-travaux pratiques, M. l'Abbé R. Schodduyn.

Telegraph address: Station Biologique Ambleteuse.

Several kilometers beyond the station at Wimereux is the "Station Biologique d'Ambleteuse" of the Catholic University at Lille, founded in 1894 by Prof. Charles Maurice. It is supported by the Catholic University of Lille, to which it belongs, and by private gifts. It is used primarily for instruction of vacation classes on excursions from the university at time of equinoctial tides and for research. It is open throughout the whole year to students and investigators without charge. About 20 students and 10 investigators are in attendance each year.

The station is located in hired buildings, a small chalet providing several research rooms, chemical laboratory, dark room, and furnished rooms for students. The main laboratory is a long, well-lighted hall adjacent to the chalet, with long tables facing the windows, providing places for twenty workers. A central row of aquaria is provided in this laboratory. The installation of a pumping plant and circulating system is planned in the near future.

The station has a small working library, a few microscopes, and a microtome and is equipped for vacation classes from the laboratory at Lille.

Literature: Maurice (1899).

THE LIMNOLOGICAL STATION AT BESSE-EN-CHANDESSE AND THE FISH-CULTURAL LABORATORY AT CLERMONT-FERRAND (PUY-DE-DÔME).

Director, Prof. Charles Bruyant, École de Médecine, 9 Rue du Port, Clermont-Ferrand (Puy-de-Dôme), France. November to July; the rest of the year at Besse-en-Chandesse.

Secretary and editor of the "Annales," M. G. Dufour.

Superintendent of laboratory at Clermont-Ferrand, M. Thomas.

Superintendent of station at Besse, M. Julian Lacombe.

Preparator of station, M. A. Pouzols.

Founded in 1893 by Prof. Paul Girod in the interests of limnology and pisciculture in one of the most picturesque spots on the "roof of France," the station at Besse was the first fresh-water station in France and one of the oldest in Europe. It was not until 1906 that the station was moved from its temporary quarters in the communal school at Besse to its present permanent building and came under the directorship of Dr. Charles Bruyant, the limnologist of Clermont-Ferrand. In 1908, in connection with the meeting of the French association at Clermont-Ferrand, its work was placed on a permanent basis and greatly extended. The station has from the outset been intimately connected with the zoological laboratory of the university at Clermont-Ferrand.

It consists at present of two parts, a laboratory of pisciculture at Clermont-Ferrand and a limnological station at Besse, the former engaged in the propagation and distribution of fish and the latter, primarily, in scientific investigation. A fish hatchery, a botanical garden, and a meteorological station are maintained at Besse in connection with the biological station.

The station, originally supported by the Faculty of Sciences at Clermont-Ferrand, is now maintained by the "Service départemental de Pisciculture du Puy-de-Dôme," receiving from it an annual subscription of 9,500 francs and an additional 200 francs from the commune of Besse.

The station is open without charge to competent investigators on application to the director. The station is located about 400 m. from the main "place" of the village of Besse, "a curious and very ancient little town" where accommodations may be secured. The station is open for work during the summer months only.

The station carries on regular explorations of the score or more alpine lakes in the neighborhood and conducts excursions from time to time to points of interest. Work upon the local fauna and flora, upon the quantity and distribution of the plankton and upon the physical conditions of the lakes, including the measurement of seiches, is carried on by the staff of the station. The researches of the station are published in a quarterly series, the "Annales de la Station Limnologique de Besse," instituted in 1909.

The station distributes over 500,000 salmonids yearly to the waters of the neighborhood and controls two of the lakes for the purposes of fish culture. A part of the output is sent to Clermont-Ferrand for early hatching and distribution to the warmer waters at lower altitudes while the remainder undergoes the slow hatching process normal to colder alpine waters (10°).

Besse is a remote mountain village lying on a tributary of the Dordogne about 50 km., in a direct line, southwest of Clermont-Ferrand. It may be reached by carriage, about 35 km., from Issoire (nine hours from Paris on the Paris-Nimes line) or by a picturesque mountain drive of about the same distance from the famous health resort, Mont Dore (twelve hours from Paris).

The station is located in a modest stone building of two stories immediately upon a mountain stream, the outlet of Lake Pavin, which supplies the water for the hatchery. It contains a limnological laboratory, supplied with running water by a hydraulic ram, and a fish-cultural laboratory in the basement, protected by double walls from freezing in winter and traversed by water from the stream. Six cement basins within the building are supplemented by out-of-door basins. The brook water is passed to a sedimentation basin, there filtered through sponges, and thence to the banks of hatching troughs of the ascending current type.

In addition to the laboratories the station building contains the workrooms and lodgings of the staff, a photographic dark room, and two chambers for visiting naturalists.

The limnological laboratory has a biological equipment and a field equipment consisting of plankton nets, sounding instruments, a Bruyant horizontal plankton net and a recording seiche indicator, Secchi disks, etc. Aquaria with running water and a compressed-air supply are provided. Large collections of plankton of local waters, and types of the local fauna and flora are found in the museum.

The station is located at an altitude of 1,000 m. in the midst of a region of alpine lakes, twenty-one lying in the field of operations at altitudes of 430 to 1,250 m. A full account of the local conditions and fauna and flora will be found in a paper by Bruyant (1904). It is a region rich in mountain streams and lies about 20 miles from the famous thermal baths of Mont Dore. It offers a quaint and charming environment, rich in waters of varied characters.

Literature: Bruyant (1896, 1900, 1904), Girod (1893), Poirier et Bruyant (1906), Ward (1900).

STATION FOR FISH CULTURE AND HYDROBIOLOGY OF THE UNIVERSITY OF TOULOUSE.

Director, Prof. Louis Roule, Laboratoire de Zoologie, Faculté de Sciences, Allées St. Michel, Université, Toulouse.

Superintendent, M. J. Audigé, Chef de Travaux, Laboratoire de Zoologie, Université, Toulouse.

In addition, two attendants.

Originally a commercial enterprise established for the culture of fish in "Bassins" for anglers from the city of Toulouse to catch, if they could, the rather elaborate undertaking finally passed into the hands of M. Antoine Labit, a wealthy lawyer of the city. His son, M. Georges Labit, was a man of wide travel with a personal interest in science as related to social amelioration. Impressed with the importance of fish culture as he had seen it in the Orient and deploring its low state of development in his native land, he conceived the idea of making of the undertaking a model culture plant, which should serve as an example for the people of the province, and developed it accordingly by establishing culture basins for native fish, by building up a museum of fresh-water fisheries and fish culture and by providing a lecture hall and an aquarium for popular instruction. His death, at an early age, in 1899, put a stop to the progress of the enterprise.

In the meantime Professor Roule had used the laboratory for some investigations and had given some lectures on fish culture in the hall. The interest aroused in the matter was so great that M. Labit in November, 1902, transferred to the University of Toulouse the entire establishment, with the buildings, reservoirs, canalizations, furnishings, and collections, stipulating only that it should be used for the advancement of fish culture, bear the name "Station de Pisciculture" and the statement that it was founded by Georges Labit, his son.

The council of the university accepted the gift and the transaction was later ratified by the President of the Republic. Since the formal transfer of the property in 1903 to the university, Professor Roule has been the director of the station, and associated with him in the practical management and improvement of the station has been his "chef de travaux," M. Audigé. In the spring of 1908 the new salmon-culture plant, erected at an expense of 40,000 francs, was completed. The estimated cost of the original plant is 250,000 francs.

The station is located about 3 km. from the center of the city on the left bank of the Garonne, in the suburbs of the Faubourg Saint-Cyprien at La Croix de Pierre at Nos. 5 and 13 Avenue de Muret and is easily reached by tram from the university.

The station is a direct dependency of the University of Toulouse, and its staff are members of the staff of the department of zoology in the university. Its affairs are controlled by the director who is professor of zoology at the university and are supervised by a "Conseil du perfectionnement" of ten members of which the director is chairman, consisting of representatives of the university, eminent fish culturists, and the chief of the hydraulic service. The functions of this body are advisory.

The budget for 1909 was as follows:

Budget of Toulouse fish-culture station for 1909.

Receipts, subventions from—	Francs.
University of Toulouse.....	4, 000
Department grants.....	1, 100
Ministry of agriculture.....	2, 000
Fisheries Society.....	1, 000
Total.....	<u>8, 100</u>
Expenses:	
Improvements.....	2, 000
Service.....	2, 400
Upkeep.....	2, 450
Publications.....	400
Water.....	550
Collections.....	300
Total.....	<u>8, 100</u>

The station is conducted primarily as a model piscicultural establishment, having for its function instruction in fish culture. For this purpose a course of seven public lectures is given in the spring of each year on the principles, methods, and apparatus for fish culture, with abundant illustrations from collections, hatching and culture ponds of the station. This course is open to all who can profit by it and is attended by 150 to 200 hearers annually. It is of the nature of university extension work rather than formal university instruction. The station also conducts a bureau for information and technical advice on the construction, installation, and operation of fish hatcheries, the care of culture basins, and food and diseases of fish.

The station keeps under culture a wide range of food fishes, primarily as a basis for instruction and information rather than for culture and distribution, though the surplus products of the station are distributed to waters of the vicinity and the mountain streams of the Pyrenees. The salmonids kept in cement tanks and reared each spring in the hatchery are the California rainbow trout (*Salmo irideus*), the brown trout (*S. fario*), the salmon (*S. salar*), and the brook trout (*Salvelinus fontinalis*). In the culture ponds are kept the bream (*Abramis brama*), goby (*Gobio fluviatilis*), tench (*Tinca vulgaris*), carp (*Cyprinus carpio*), perch (*Perca fluviatilis*), chevaine (*Squalius cephalus*), the frog, and crayfish.

The aquarium, museum, and grounds of the station are open to the public on Sunday afternoon for inspection.

The lines of investigation in progress at the station are the acclimatization of the salmonids to the warm waters of the lowlands, improved methods of hatching, feeding, and rearing fish, hybridization and the introduction of new forms, and an investigation of certain protozoan and bacterial diseases of fish.

Under the auspices of the station there is issued a quarterly "Bulletin Populaire (Revue générale, technique et pratique) de la Pisciculture et des Améliorations de la Pêche," with the director of the station as editor.

The building is a plain two-story dwelling (6 by 36 m.) with the long façade upon a passageway and the other fronting upon the garden, which contains the culture basins. This building contains on the ground floor, in addition to the quarters of the keeper, the vestibule, a laboratory for the study of the physiology and pathology of fishes, public office, and an aquarium room (5.5 by 14 m.). The floor above contains a lecture hall (5.4 by 16 m) whose walls are adorned by an extensive collection of samples and illustrations of the implements and apparatus used in angling and in commercial fisheries. The room is arranged for stereopticon. A corridor, whose walls are hung with maps and charts illustrating the distribution of fresh-water fish and giving graphically the statistics of fish culture, leads to the museum (5.7 m. by 8.3 m.), containing a complete collection of the fresh-water fishes of western Europe, exhibiting their different races and their anatomical structure, especially those of taxonomic value. A second part of the collection exhibits the developmental stages of a number of species from egg to the adult, with a supplementary microscopical collection. There is also a representative hydrobiological collection of species of plants and animals related to fish culture as food or enemies of fish. The adjoining rooms serve as investigators' laboratories and are equipped for microscopical work and dissection.

Adjoining the main building of the station is the large new piscicultural laboratory (about 20 by 20 m.) equipped with cement hatching troughs of a new pattern. In the garden are the cement water tower with machine house beneath, the sheltered salmonid basins, the great reservoir, and the extensive culture basins.

The grounds of the station contain 11,788 sq. m., of which over three-quarters are at present occupied by the buildings and culture ponds. The water supply of the station is drawn from the terminus of an irrigating canal, the "St. Martory," which follows the left bank of the Garonne from the Pyrenees for a distance of 80 km. It delivers per hour to the station about 180 cu. m. of mountain water free from any contamination. The water is discharged from pipes from the canal 4 km. distant directly into a great reservoir (18.8 by 57.2 by 2.75 m. with a capacity of 2,800 cu. m.), which is contained within massive buttressed walls 3 m. in height. A smaller reservoir (4.1 by 60.9 by 22 m.) has a capacity of about 500 cu. m. From the reservoirs the water is carried to the aquarium room, to the culture basins, and to the river. The main reservoir serves as a sedimentation basin, whence the clear water is drawn off into the smaller reservoir, flowing out over rocky terraces to the culture basins below. It

also contains sufficient water to carry the plant during periods of repair to the canal.

The culture basins are 11 in number, with a surface area of about 8,000 sq. m. They are all sunk in the ground, with walls and bottom of cement. There are 11 rearing basins, comprising six long basins, four annular basins, and a model vivier. The last named is a large basin (9.9 by 39.8 by 2.3 m.) with one end harboring a sloping bank of water plants, with submerged tubs of water lilies whose leaves provide shade for the fish, and floating rafts of water cress and pots of gentles. This vivier is used for a demonstration pond for culture of carp, tench, and bream.

Adjacent to this are six long parallel basins (each 3.8 by 66.2 by 2.2 m. deep), between long lines of sheltering plane trees, each destined for the culture of a particular species of fresh-water fish. The four annular basins each surround an island 6 to 10 m. in diameter, are 3 m. in width and 1.75 m. in depth. One is used for fry of trout and perch, for pike and eels, a second for crayfish, a third for acclimatization experiments, and the last for frogs.

The salmonids are kept in sheltered cement tanks sunk in the ground and covered with wire screens. The tanks are supplied with water pumped from a well sunk into water-bearing sand strata.

The aquarium room is furnished with several score of aquaria of assorted sizes, a large floor basin, and rows of floor tanks. It is used for observation, experimental work, and work with fish diseases.

Literature: Roule (1904), Zacharias (1905).

FISH CULTURAL LABORATORY OF THE UNIVERSITY OF GRENOBLE (ISÈRE).

Director, Prof. Louis Leger, Laboratoire de Zoologie, Université Grenoble, Isère.
Dr. L. Perrier, Chef des Travaux, Université Grenoble.
Preparator, Dr. Ed. Hesse, Université, Grenoble.

Founded in 1901 by Professor Leger, this laboratory is intimately associated with the University of Grenoble and is essentially a laboratory for research and experiment.

In its organization, its relations to research and education, and to popular instruction this laboratory is remarkably similar to our own agricultural experiment stations associated with our state universities. Indeed it forms an excellent model for an aquicultural experiment station, uniting as it does scientific research of the highest order with laboratory experiment and field culture, and the practical instruction of foresters and others in modern scientific methods of fish culture. The advisory relation which exists between the station and the fish culturists of southeastern France is also similar to that which has arisen in agricultural matters between our experiment stations and the farming communities.

The activities of the station exhibit a happy combination of work in the fields of both pure and applied science. The rearing of considerable numbers of young salmonidæ affords material for the investigation of various questions of hydrobiology and ichthyopathology and for experimental improvement of the methods of fish culture. The lines of investigation followed are these:

1. The rearing and acclimatization of various salmonids in the experimental ponds (*Salmo irideus*, *Trutta fario*, *Salvelinus fontinalis* and *S. umbla*) are undertaken with a view to determining the best species for introduction into the various ponds, lakes, and streams, without detriment to the native trout (*Trutta fario*) and of extending the planting and culture of fish into new territory, both in high cold Alpine waters and the warm streams of the lowlands. Success has attended these efforts.

2. Streams are methodically examined throughout their course to establish their relative nutritive values and to determine not only their "capacité biogénique" but also the best regions for planting young fish. In this way useless planting, overplanting and underplanting are eliminated and greater returns for the outlay of time and money secured.

3. The intensive culture of different salmonid fishes in small areas is carried on in the experimental ponds.

4. The laboratory gives gratuitously to private individuals and fisheries societies information and advice regarding piscicultural matters and has thus been of great service in the active extension of pisciculture among landed proprietors in recent years. It also conducts an active propaganda in this direction, holding public institutes, with addresses and conferences, for the government agents of waters and forests, for fisheries societies, and others both at the university, and in neighborhoods where fish culture is practical or is possible.

5. The laboratory also conducts in conjunction with competent chemists investigations upon harmful industrial wastes in their relation to stream pollution.

6. Scientific investigations in ichthyopathology, with special reference to "Cancer thyroïdienne" of the trout and the parasites of fishes and crayfish which are the cause of diseases, often of very destructive types.

The resources of the station do not provide research laboratories with facilities for many others than the staff, in fact, the scientific research is largely done as at the Fischereiversuchsstation at Munich, in close conjunction with an established laboratory to which students and investigators are admitted, in this case the zoological laboratory of the University of Grenoble. Students and investigators will find here, under the direction of Professor Leger, one of the most productive

centers in Europe in the study of parasitic protozoans, especially those of the lower animals.

The members of the staff of the station are all members of the staff of the zoological laboratory, and the entire annual budget of 2,000 francs, granted by the ministry of agriculture and the local department, is used in the maintenance of the experimental and fish cultural side of the work.

The station is located at Grenoble, 120 km. or two and one-half hours southeast of Lyon, and is compactly housed in the science building of the university. It occupies several rooms, one of 40 sq. m. used as a hatchery. This room is an admirable model of compactness and though small (4 by 7 m.) provides for the hatching and rearing through the early stages of growth of 30,000 to 40,000 salmonids yearly.

This room is carefully ventilated, has a supply of running cold water (11°) and is maintained throughout the year at a constant temperature of about 12° C. In the warmer (15° to 25°) research room the cyprinid fishes and the American sunfish (*Eupomotis gibbosus*) and catfish (*Ameiurus nebulosus*) are kept for experimental purposes.

The hatching is carried on in five batteries each of four troughs of the modified Coste type, each with a capacity of 2,000 eggs, and supplied with three to four liters per minute. These hatching troughs are of glazed yellow earthenware.

After hatching, the alevins are distributed to the low aquaria in the center of the room. Each tank (75 by 40 cm. and 12 or 18 cm. high) holds 2,000 to 3,000 fish and requires 3 to 4 liters of water at 12° C. per minute. The low sides facilitate the sorting of the eggs and attention to the aquaria. Minced spleen and curds are used as food. In two or three months the alevins are transferred to the larger aquaria (75 by 40 by 40 cm.) along the wall, where they rapidly attain the size (5 cm.) suitable for planting. Individuals reserved for breeding are kept throughout the year in larger aquaria (2 by 0.8 by 0.5 deep) containing 800 liters and supplied with 4 liters of water per minute by overhead spray. As many as 100 trout of 20 cm. length may be kept safely in such an aquarium. It is necessary, however, that the individuals in an aquarium should be about the same size to prevent cannibalism. Trout reared in these aquaria attain a weight of 1 km. in four to five years in spite of restricted quarters. Three long cement floor tanks receiving the overflow from the aquaria are used for storage of diseased fish, while the long cement floor tank (7 by 0.4 by 0.5 m.) below the aquaria along the wall serves for the large individuals used as breeding stock or for *Astacus* used in parasitological researches. Along

the opposite wall, below the aquarium shelf, is a narrow cement trough for running water in which *Gammarus* is reared for trout food.

The hatchery is also equipped with an amphibian cage, reservoir for rearing frogs and salamanders, and a series of small aquaria for the study of the nutritive value of various waters. The equipment also includes aerated tanks for the study of the action of industrial wastes upon the waters and fish of the region.

The piping throughout is of lead with brass cocks. The aquaria are fed by overhead sprays discharging from an elevation above water level of 20 to 35 cm.

In addition to the hatching room the station contains a laboratory of ichthyopathology and a museum, each with an area of about 20 sq. m. The museum contains a complete collection of the fresh-water fishes of France, models of their anatomy and stages of development, a unique collection illustrating the pathology of fishes, including an especially fine exhibit of thyroid cancer of the trout, and of the parasites of fishes. There is also a series showing the pathology and monstrosities of alevins and an exhibit of the apparatus for hatching and transport of eggs and alevins. Adjacent to the museum is a large lecture room used in the extension work of the station.

The research laboratory in ichthyopathology is combined in part with that of the zoological laboratory of the university and has the usual equipment of such institutions. In this room are the hydrobiological collections illustrating the fauna of torrents and alpine lakes, growth stages of fishes, and the enemies of fishes and their eggs and fry.

The field equipment of the station consists of a series of 5 experimental basins distributed at various altitudes (275 to 1,500 m.) and supplied with different types of water. Full records are kept of the number, size, and weight of the fish planted in these basins; and their rate of growth, quality of flesh, reproductive capacity, diseases, etc., are methodically determined, in conjunction with a physical, chemical, and biological study of their environments. In this way a scientific basis for a rational culture of the alpine waters of the neighborhood is being effectually demonstrated. A hatchery is attached to one of these field stations.

The scientific results of the station are published in various journals and those pertaining directly to problems of pisciculture are assembled and reissued in one or two fascicles annually under the title "Travaux du Laboratoire de Pisciculture de l'Université de Grenoble," the first fascicle appearing in 1909.

Literature: Leger (1908, 1909), Lefranc (1908).

THE FISH CULTURAL STATION OF BORDEAUX.

Director, Prof. J. Kunstler, Laboratoire de l'Anatomie Comparée et de l'Embryologie, Université, Bordeaux.

For several years past a local fisheries society in conjunction with Professor Kunstler has maintained an experimental station for fish culture whose aims are mainly practical.

ABANDONED STATIONS.

Several stations founded in earlier years in France have ceased to exist. These are the station of Fol and Barrois founded in the seventies at Nice, which was given up on the opening of the French station in 1880 at Villefranche, which in turn was abandoned after the cholera outbreak of 1882 and the opening of the Russian station at that place. In 1882 in connection with the aquarium of the zoological garden at Havre, a station, which was an annex of the laboratory of physiology at Paris, was opened with Professors Gibert and Paul Bert as directors. The station was discontinued on the death of Bert in 1886.

In the latter part of the eighties M. Ch. Bettencourt, a naturalist of Boulogne opened at his own expense a small laboratory at Portel, which, until his death, was hospitably opened to students and naturalists of the Wimereux station.