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BETWEEN STATIONS AND HABITATIONS:
The Architecture of French Science at the Shore, 1830–1900

by

Edward A. Eigen

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Signature of Author . . . .
Edward A. Eigen
Department of Architecture
January 7, 2000

Certified by . . . .
Stanford Anderson
Professor of History and Architecture

Accepted by . . . .
Stanford Anderson
Chairman, Departmental Committee on Graduate Students

Dissertation Committee

Mark Jarzombek, Associate Professor of History and Architecture

Leila Kinney, Lecturer in the Department of Architecture

Reader

Akos Moravánszky, ETH Zurich, Professor of Architectural Theory

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ABSTRACT

This dissertation introduces a group of mutable institutions of research which emerged along the coast of France in the nineteenth century. The setting of these stations gave rise to a manner of occupation, both in the sense of physical inhabitation and of intellectual orientation, distinct from but related to the cultural institutions of the city. Their very remoteness resulted in structures with an unusual "double program": one of research and one of habitation. In examining the architectural, visual, and scientific components of this double program, the dissertation reveals a profound connection between the domestic and natural economies which ordered these places of research. This connection, I argue, provides the basis for a new understanding of ordering space on the related scales of architecture, landscape, and region.

The first part of the study identifies a moment of cultural criticism in which a group of naturalists vacated the existing edifice of knowledge. Physically and intellectually abroad in a new field of research, their efforts to accommodate themselves there constituted a particular understanding of place in the production of knowledge. A tension between mobile and fixed modes of experiencing place determined the structural features of these accommodations. This tension is shown to be an important conceptual feature of nineteenth-century architectural, historic, and scientific accounts of man's place in nature.

The second part of the study presents the thesis that these stations did not merely facilitate a research discipline but served as its premise. Focusing on the development of two stations which were "annexes" of the Paris Sorbonne, it shows how they were shaped by a practical and political bias against scientific institutions conceived as monuments. It argues instead that in comprehensively managing the elements of time, place, and circumstance these stations were instruments for mediating the natural world. The unique and undocumented visual practices for which they were the site ultimately revealed the physical and philosophical limits of the project of knowledge that they set in motion, and of vision itself.

Thesis Supervisor: Stanford Anderson
Title: Professor of History and Architecture

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INTRODUCTION

ON MOVING BETWEEN DISCIPLINES, OR FINDING A HOME AWAY FROM HOME

This dissertation introduces a group of mutable institutions of research which emerged along the coast of France in the nineteenth century. These institutions were as much a product of the desire to understand the particularities of specific places, as they were the instruments for making the nature of those particularities known.[1] Their setting gave rise to a manner of occupation, both in the sense of physical inhabitation and of intellectual orientation, distinct from but related to the institutions of the city. Their very remoteness resulted in structures with a "double program": one of research and one of habitation.[2] On the side of research, these stations structured a way of seeing, knowing, and acting upon an entirely new world: the sea. They mediated the experience of a milieu which was dense with images, memories, tradition, lore, stirred by physical forces known and unknown, yet which was a "territory of the void," as the historian Alain Corbin has described it.[3] Equally, the edge of the sea provided an unsuspected laboratory for studying the nature of human habitation, the naturalists who went

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[1] The attempts to piece together the elements of this history have been limited; they include the pamphlet by Georges Petit, *"L'Histoire de la Biologie Marine en France et la Création des Laboratoires Maritimes* (Paris: Histoire des Sciences, 1962); Maurice Caullery, "Les Stations Française de Biologie Marine," *Notes and Records of the Royal Society of London* 8 (1950), pp. 95–115.

[2] Julien Guadet, *Éléments et Théorie de l'Architecture* (Paris: Librairie de la Construction Moderne, 1901), II, p. 285; on Guadet's notion of the "scientific" component of design, see Reyner Banham, *Theory and Design in the First Machine Age* (London: The Architectural Press, 1960), p. 18.

[3] Alain Corbin's book *Le Territoire du Vide* has been translated by Jocelyn Phelps as *The Lure of the Sea* (Berkeley: University of California Press, 1994).

there having to recreate for themselves selected elements of home. My thesis is that these stations did not merely facilitate a new mode of experiencing nature, but served as its premise.

The study of these stations does not proceed strictly either from built artifacts, or from idealist notions of observation or experiment. Instead, it begins with the question of how these stations made the sea (as a vital milieu) knowable to researchers—and how a distinct approach to planning space emerged from the attempt to structure such an encounter. The allied practical and theoretical means of understanding and hence managing the elements of time, place, and circumstance which were constitutive of observation and experiment represent a branch of knowledge which, in its intersection with architectural constructions of knowledge, is posited here as a field of inquiry.

Writing the history of France's marine research stations poses a number of problems regarding existing historiography as well as of disciplinary boundaries. This study draws on the history of architecture and the history of science, as well as literary, visual, and archival sources in an effort to examine diverse forms of mediating the natural world. If the human understanding of nature is in some sense constructed, it is necessary to look to a broad range of disciplines to see how that construction is inhabited. From the increasingly far-ranging field of the history of science, a number of studies have focused on diverse places of research and pedagogy. These include research into practices related to field work and the types of planning and of improvisation which it requires.[4] One important structural feature of these studies is the opposition of the field as a place of observation and the laboratory as the "proper" domain of

[4] See in particular Henrika Kuklich, Robert Kohler, eds. *Science in the Field, Osiris* 11 (1996); N. Jardine, J. A. Secord, E. C. Spary, *Cultures of Natural History* (New York: Cambridge University Press, 1996). Among these are a number of studies on American marine research stations and the famous marine laboratory constructed in Naples by the German Anton Dohrn. Jane Maienschein, "History of American Marine Laboratories: Why Do Research at the Seashore?" *American Zoologist* 28 (1988), pp. 15–25; Keith Benson, "Why American Marine Stations?": The Teaching Argument," *American Zoologist* 28 (1988), pp. 7–14; Lynn Nyhart, "Civic and Economic Zoology in Nineteenth-Century Germany, The 'Living Communities' of Karl Möbius," *Isis* 89 (1998), pp. 605–630.

experiment. In fact, here we will examine the migration of the laboratory into the field, and the unconventional settings it occupied. Helpful in this regard is recent scholarship which has examined the link of the laboratory to domestic spaces in early modern Europe.[5] Yet while a number of these studies offer compelling insights into the places in which science was pursued, they fail to pose the question of place as such.

It is only recently, with the collection of texts by Peter Galison, *The Architecture of Science* (1999), that concerted attention has been given to the architecture of science per se. In his introduction, Galison defines his approach as follows: "We are after the scientific subject inhabiting the scientific edifice and presupposed by it; and we are after the architectural subject that has itself been drawn in the confrontation with science."[6] The statement is compelling in underscoring the difference between the occupations of the scientific and the architectural subject: the "inhabitation" of the scientific subject implies a far greater duration than the confrontation into which the architectural subject is drawn. In other words, the scientist's act of inhabitation might serve as the only means for revealing the nature of the architect's plan, the product of his possibly short-lived engagement with the design problem. To be sure, the methods, assumptions, and capacity for invention which the architect brings to the exchange are by no means negligible factors in what Galison has usefully framed as an inter-subjective—as opposed to an interdisciplinary—process of design.

That modern architecture has sought legitimacy in various forms of scientism further complicates the issue of what resources the architect and naturalist draw on and how they define themselves as agents in the production of the architecture of science. The tendency in

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[5] See Steven Shapin, "The House of Experiment in Seventeenth-Century England," *Isis* 79 (1988), pp. 373–404; Deborah Harkness, "Managing an Experimental Household," *Isis* 88 (1997), pp. 247–262; Paula Findlen, "Masculine Prerogatives: Gender, Space, and Knowledge in the Early Modern Museum," in Peter Galison, Emily Thompson, eds., *The Architecture of Science* (Cambridge: MIT Press, 1999), pp. 29–58.

[6] Peter Galison, "Introduction," *The Architecture of Science*, p. 3 (see note 5).

architectural writing to state theses or to interpret historical development by means of scientific metaphor or analogy is pronounced.[7] The power of metaphor, Adrian Forty writes in a discussion of the trope of circulation, stems from a perceived difference between science and architecture. Drawing productively on the conclusions of Alberto Pérez-Gómez, Forty argues that writers in architecture employ such metaphors in the belief that, at base, architecture is not a science, and may not go where science can.[8] The connection of meanings which such tropes create can be read as masking the difference between the fields in which those meanings emerged. Just as prevalent is the use of analogy to naturalize works of architecture or the design principles which underlie them. Antoine Picon indicates the self-proclaimed use to which Eugène Viollet-le-Duc put the anatomist Georges Cuvier's method of comparative anatomy. But however seductive Viollet-le-Duc's drawings comparing skeletal joints and structural bearings are, such analogies are at base false.[9] Perhaps more damaging to our understanding of the relationship between architecture and science is that analogy, however ingenious, often conceals a more fundamental basis of understanding.

Accordingly we will examine our stations without witting recourse to this kind of rhetorical conceit. Instead of taking metaphor or analogy as a ready-made object in which unrelated meanings have been connected, the current study examines elements of experience which were common to the fields of architecture and science but were managed by them in different ways. In this regard, a reading of Jules Verne's novel *Twenty Thousand Leagues Beneath the Sea* (1871) examines how language itself stages the fallibility of different ways of looking at

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[7] For a useful attempt, see the section on biological analogy in Peter Collins, *Changing Ideals in Modern Architecture* (Montreal: McGill-Queens University Press, 1965); a rather less successful study is Philip Steadman, *The Evolution of Designs* (New York: Cambridge University Press, 1979).

[8] Adrian Forty, "'Spatial Mechanics': Scientific Metaphors in Architecture," in *The Architecture of Science*, pp. 213–231.

[9] Antoine Picon, "Architecture, Science, and Technology," in *The Architecture of Science*, pp. 309–336.

and subsequently speaking about nature. More generally, it seeks to describe facets of an episteme, as Michel Foucault described it in his archaeology of classification, representation, and exchange. His purpose was to create a "regional" study, an "epistemological space" specific to a particular period. Indeed, the range of knowledges which these stations organized at the edge of the sea can be considered in a literal sense one such epistemic region. Historically, it takes up precisely where Foucault's project ended: with Cuvier's toppling of the glass jars of the museum, exposing the animals within to new forms of visibility, a new order of knowing.[10]

Indeed, our naturalists did something more radical than shattering the jars of the museum: in their effort to study living nature *in situ*, something which could not be accomplished in lecture halls, libraries, or laboratories—at least not those in the city—they defined what could be called an extra-mural project of knowledge. The urgency with which new types of institutions were anticipated resulted in part from the notorious lack of proper research facilities in Paris at the Sorbonne and such vaunted scholarly establishments as the Muséum d'histoire naturelle. Yet something more is meant here by an extra-mural project than the desire to remedy a shortage of space. In order to exploit the enormous research potential of the coast, researchers had to vacate the existing edifice of knowledge, if only for a season each year. It was in this act of extension, of transporting carefully selected elements of these urban institutions into new settings, that the physical and intellectual contingency of their status was first felt. They were abroad in a new field of research with few landmarks and no accommodations. Our study begins, then, with a dense account of their method of seeing, measuring, and recording the places in which they found themselves. In this range of practices is to be found the rudiments of an approach to ordering places of research.

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[10] Michel Foucault, *The Order of Things* (New York: Vintage Books, 1973), p. 139

Introduction

The attempt to understand place as a precondition to architectural construction consists in trading the notion of singularity for that of particularity. To begin with, the singular enclosed space of the research cabinet is replaced by the dynamic experience of open space in all its particulars. This initial move occurs on the first page, as it were, of the numerous narratives of research conducted along the shore in the 1830s-50s: the researchers had to configure their field of knowledge on the move, keeping account of when and where the objects of study were to be found. Their desire to move their "seat of observation" from one station to the next as favorable circumstances presented themselves involved more than just movement in terms of changing the place of their research (*déplacement*), but in a more profound sense of moving their base of research (*déménagement*). The question of the beginning and end point of these movements, the route they followed, and the rate at which they progressed, I argue, are essential to the consideration of the place of research as such. Each naturalist's work as a statistician, the company he kept with hydrographers, the reports he wrote on the fisheries and even the incidence of shipwreck, all constituted related practice for understanding this order of particularity.

This study proposes a discourse of place and how it is experienced in movement and through settlement—both of which are central to understanding the unique culture to which the research station gave rise. This is demonstrated, in part, through a discussion of a neglected strain of nineteenth-century architectural theory, the premise of which was not a tectonic ideal, but rather the historic forces which acted on the patterns of migration and settlement which ultimately gave rise to the national homes and homelands of Europe. The tension between mobile and stationary forms of experience is shown to have deep implications for the emergence of the habitation and how it served as a means of managing external circumstance. The acts of managing a household rather than particular forms of habitation are examined as central features to arranging conditions for research. In the early, so-called nomadic phase of the naturalists' explorations, a large part of their effort was spent in researching proper habitations for themselves. The first settings of their combined habitation and research were improvised, with naturalists converting hotel rooms or houses which were lent to them into proper research spaces. The necessity of naturalists to manage a household, it is argued, had implications both practically and historically for the emergence of their research discipline.

In examining the architectural, visual, and scientific components of this double program, the dissertation reveals a profound connection between the domestic and natural economies which ordered these places of research. The study proceeds in a somewhat self-reflexive way by showing that the research practices which certain arrangements along shore made possible resulted from the intense consideration naturalists gave to the mutual arrangement of objects of nature and from their own situation as observers. Their conception was at base an economic one. To interpose here the term "economy" is not merely to fall back on metaphor. Rather, in its lexical derivation from *Oikos*, the household, "economy" implies a set of social, managerial, and physical relationships which structure places of habitation. In fact, the very terms "stations" and "habitations" had significance within a discourse which emerged during this period to study how such places were distributed in time and space. Thus the concept of economy, and its cognate term "distribution," will be regarded historically as one of the important outcomes of the naturalists' research, and as a significant methodological component of that research.

Not incidentally, among the chief theoretical contributions of Henri Milne-Edwards, who initiated the movement to study living nature along the coast, was the concept of the physiological division of labor. Drawing on an analogy between organisms and the workings of industrial factories, the concept was quickly and widely interpreted as having significance for the organization of the household and society. In examining the relation between human and animal societies, Milne-Edwards's student Alfred Espinas pointed to the origins of society in the gathering of men within the same "habitation" through mutual ties of dependence.[11] In more concrete terms, the household organization of two research station, Roscoff in Brittany and Banyuls on the Mediterranean, serve as case studies to examine the social discipline which was part and parcel of the formation of research naturalists in these settings.

The case studies also raise the question directly of what kind of architecture the stations represented. There is an important continuity between the conceptualization of the laboratory as composed of "air, light, and space," and the desire expressed by naturalists working in the field to master the elements of time, place, and circumstance.[12] This study proposes an understanding of the emergence of the laboratory as a modern building type. Writing after the fact in 1901, the academic theorist Julien Guadet noted that creating a composition which answered to the highly specific program of the laboratory deprives the architect of the crutch of symmetry or any other seductive design device. Indeed, despite the unremarkable external appearance of the stations, the incorporation of the very elements of experience into their planning reveal them to be engaged in a particularly modern architectural conception of situating subjects and objects of research.

Another aspect of the status of the architecture of science in France is revealed in a discussion of the École Pratique des Hautes Études. The École was not an isolated institution, but was a consortium of sites of research. Comprised of so many "colonies" of science, its ground plan spread throughout institutions all over France. The École was anti-monumental in that it proposed no new buildings, but merely involved shoring up the "foundations" upon which French science rested. Arguably, these foundations were less physical than conceptual in nature, consisting of means of creating an edifice of science in the absence of actual new construction. In time, new buildings were added to the stock of facilities which comprised the

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[11] Alfred Espinas, *Histoire des Doctrines Economiques* (Paris: A. Colin [1891]), p. 27.

[12] Guadet, Éléments et Théorie de l'Architecture, p. 273.

École. But as is exemplified by our case studies, particular emphasis must be placed on the distinction as it was then being articulated between the container and the content of science. Namely, scientific structures needed to be flexible and expandable, and no resources were to be spent on luxury or ornament which might otherwise go to providing the proper conditions of research.

Important aspects of what has been described as an anti-monumental approach to science in France must also be read in the context of the very different fate of laboratories in Germany. As Guadet described it, each academic chair was connected (at least in principle) to a unique arrangement of spaces; after passing through a doorway inscribed with the words "Zoology," for instance, one was in the physical domain of that discipline. In Germany, he noted, these chairs were known more grandly as institutes. An important difference on the order of architecture was implied by this designation. The institutes constructed in Germany were important urban structures, which became the object of curiosity and envy on the part of French scientists at a time of fierce national rivalry. An understanding of the French scientific edifice must take some account of the reaction of officials and scientists to the place these institutes occupied in the "disciplinary landscape" of neighboring Germany.[13]

This study attempts to introduce the thesis that notions of place, as well as associated practices of observation and experiment, were intrinsic to the planning of institutions which separated themselves from the *urbs*, specifically Paris. A distinct notion of the city will emerge in considering the particularity as opposed to the singularity of these places, a notion which subordinates the distinction between city and country to their more fundamental mutual identity as sites for and repositories of specific forms of physical and intellectual labor, of occupation. The urban artifact, regarded in this way, is the necessary and inevitable setting for a branch of research which saw natural "fact" as the result of a type of making, from the French

[13] Timothy Lenoir, *Instituting Science* (Stanford: Stanford University Press, 1997), p. 100.

fait.[14] Such an analysis involves a different set of considerations than those put forward, say, in the study of the seaport as an important model of urban morphology.[15] Indeed, it will be necessary to dispense with a narrowly topographic approach, beginning instead with an investigation of how this field of study was charted in the tradition of statistical tableaux. The idea of the city will be examined with regard to structures which mediated the intellectual and real geography traversed by this group of originally nomadic naturalists.

The city's legibility as a particular place, as a pattern of settlement, will be examined through the social and the disciplinary order of the household where the double program was given shape. The practical concern with housekeeping, a part of the naturalists' original forays to the coast, was more than merely incidental to their future development. Historically, I argue, it was connected to a discourse on the origins of man's efforts to manage the external environment through the perfection of his domestic foyer. In such a context we witness the theoretical formulation of social order, with reference to the physiological division of labor which, beginning with the unit of the family, was intrinsic to the evolution of the social collective. The household, in this case the household of science, forms the core of a newly instituted *civitas*. An examination of the notion of economy which governed it, I argue, is more revealing of how the city—embracing the house and the region—was conceived than a gloss of the wide rhetorical use of organic images to describe the city in the nineteenth century. Suffice it to note that the organic analogy ran in both directions: to wit, Maxime du Camp's *Paris, ses Organes, ses Fonctions, et sa Vie* (1870) and the physiologist Claude Bernard's notion that the body had its districts each populated with different craftsmen and laborers.

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[14] I refer here to Aldo Rossi's discussion of the city as an artifact and "artificial homeland," see *The Architecture of the City*, trans. Diane Ghirardo, Joan Ockman (Cambridge: MIT Press, 1988), p. 34.

[15] See Bruno Fortier, Alain Demangeon, *Les Vaisseaux et les Villes* (Brussels: P. Mardaga, 1978); Josef Konvits, *Cities & the Sea: Port City Planning in Early Modern Europe* (Baltimore: Johns Hopkins Press, 1978).

The particular notion of the city suggests an *other* institutional model; one which reconstituted social and intellectual life out of architectural elements and locally available resources which at first might seem unable or even inappropriate to sustain them. As a point of departure, I pose a specific challenge to the status of the museum, which in the case of the Muséum d'histoire naturelle of Paris was conceived specifically as a "metropolis of science." The Muséum played a decisive institutional role in collection and classifying the objects of nature. But the "museological evolution"[16] of the Muséum itself, which tended to emphasize accumulation and display, and culminated in the construction of the Grand Gallery in 1889 was not necessarily in the interest of research or the making of new knowledge. To be sure, the new gallery was considered "a spacious and magnificent monument,"[17] but in many important respects it failed to respond to "the movement which was everywhere afoot in the natural sciences."[18] It is this tension between the established order of the monument and the unfolding of experience in movement which provides the reason for relegating the paradigm of the museum and its ever growing discourse to a subsidiary place in this study.[19]

Indeed, it was the movement which was afoot which led the naturalist Edmond Perrier to ask the Muséum's Assembly to consider the construction of a laboratory situated by the sea.

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[16] Camille Limoges, "The Development of the Muséum d'Histoire Naturelle of Paris, c. 1800–1914, in Robert Fox, George Weisz eds., *The Organization of Science and Technology in France 1808–1914* (New York: Cambridge University Press, 1980), pp. 233–34.

[17] Edmond Perrier, "Le Laboratoire Maritime du Muséum d'Histoire Naturelle," *La Nature* 794 (August 18, 1888), p. 186.

[18] Archives of the Muséum Nationale d'Histoire Naturelle, Registre des Procés-Verbaux des Séances de l'Assemblée des Professeurs Administrateurs du Muséum d'histoire Naturelle (Novembre 15, 1881), p.179.

[19] Useful studies on the culture of the museum include: Sophie Forgan, "The Architecture of Display: Museums, Universities and Objects in Nineteenth-Century Britain," *History of Science* 32 (1994), pp. 139–162; Peter Vigo, ed., *The New Museology* (London: Reaktion Books, 1989); Oliver Impey, Arthur MacGregor, eds., *The Origins of the Museums: The Cabinet of Curiosities in Sixteenth- and Seventeenth-Century Europe* (Oxford: Oxford University Press, 1985); George Stocking, ed., *Objects and Others: Essays on Museums and Material Culture* (Madison Wisconsin: University of Wisconsin Press, 1985); John Elsner, Roger Cardinal, eds. *The Cultures of Collecting* (Cambridge: Harvard University Press, 1994).

Perrier's proposal carried its own criticism of the Muséum. The Gallery, he wrote, was a "spectacle," arranged from the point of view of achieving pleasing effects.[20] At the time, a debate emerged among the Muséum's professors, who also served as its administrators, over the scientific versus the "decorative" arrangement of the contents of the new gallery. Yet if the specimens were to have "a pleasing aspect and harmony," it would only result from a sensible ordering principle. But something more was at issue than even the natural method for ordering nature and the settings which made it legible. This was to be found in comments by the professor of zoology, Georges Pouchet, that the "contents" of such a spectacle were destined to "gather dust."[21] Their immobile state was the very antithesis of the movement Perrier described, except that the dust was stirred up by the shuffling feet of a public which the Muséum turned into spectators of nature. In beginning this study with a discussion of a range of movements, routes, indeed with the very definition of the research station as a time-place, attention is redirected to a manner of experiencing nature which neither was nor could be staged in advance. The "contents" of this experience were determined, at least in part, by what could be fashioned of the elements of the places in which the naturalists found themselves.

In the movement to the shore and the evidence of the life led by the naturalists, we find a point of orientation to initiate a discussion of the turn of events which took place within these institutions in architectural terms. It is vital to recognize that the biographical particularities of these naturalists, insofar as they chose to venture out from the security of the city, the museum, and the conventional limits of scientific knowledge, function more broadly as indispensable evidence of a new discursive and practical paradigm. Like characters of a *Bildungsroman*, their movement from the known to the unknown, their discoveries at the margins of the social

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[20] *La Revue Hebdomadaire* (September 6, 1913).

[21] In Walter Benjamin's imagination of nineteenth-century Paris, dust was material evidence of the motionlessness of history; the dust was stirred up and resettled on things found in left-over places, see Susan Buck-Morss, *The Dialectics of Seeing* (Cambridge: MIT Press, 1989), pp. 95–96.

discourse, and their ultimate re-incorporation into new institutions provides a historical narrative richly deserving of readers. In following their lead, we do no merely gain access to the institutions which they occupied, but recover the impressions and nascent ordering of nature to which they were dedicated.

In charting this development, the chapters follow three generations of naturalists, beginning with their departure from Paris and following a historic trajectory which leads to the establishment of research stations. The study begins in the late 1820s, with the voyage of Henri Milne-Edwards (1800–1885) and his friend and colleague Victor Audouin to the coast of Normandy. At the time, Audouin held the chair in entomology at the Muséum, which Milne-Edwards assumed after his untimely death in 1841.

Through his teaching, Milne-Edwards inspired a generation of naturalists to study at the shore before there were any facilities there to accommodate them. Notable among them was Armand de Quatrefages (1810–1892), who as a student earned money preparing the drawings for the revised edition of Cuvier's *Règne Animal*, which Milne-Edwards was then editing. Quatrefages replaced Audouin as Milne-Edwards's travel and research companion on an important voyage to Sicily. Quatrefages wrote about that voyage and others he undertook independently in a series of articles in the *Revue des Deux Mondes*, later published as *Souvenirs d'un Naturaliste* (1854), an important source of images for the emerging culture of littoral research.

It was Milne-Edwards's student Henri de Lacaze-Duthiers (1821–1901) who promoted the actual construction of marine research stations. Earning his doctorate in 1853, he first served as Milne-Edwards's assistant before going on a series of voyages to Brittany and the coast of the Mediterranean. Upon completion of these voyages, Milne-Edwards helped him get a professorship at the newly created Faculty of Science at Lille, where Pasteur was dean of science. He returned to Paris in 1864, assuming a professorship at the Muséum, which he subsequently resigned in order to take one of the two chairs in zoology, anatomy, and comparative physiology at the Faculty of Sciences (the other one was held by Milne-Edwards). In 1872, Lacaze-Duthiers established Roscoff as the first permanent research station in France; the Arago laboratory on the Mediterranean was founded a decade later. In different ways, the two stations served as the model for the nearly dozen stations which arose before the end of the century.

As the first researcher to receive a stipend to study at Roscoff, Lacaze-Duthiers's student Edmond Perrier (1844–1921) is the chief representative of the third generation. An ardent student of evolution, a position to which neither Milne-Edwards nor Lacaze-Duthiers subscribed, Perrier became a professor at the Muséum d'histoire naturelle and eventually its director. His efforts to create the Muséum's own research station in the Bay of the Seine were realized in 1891, effectively bringing full-circuit the narrative which began with Milne-Edwards's departure from the Muséum.

Chapter I

AN UNMARKED ROUTE

"Plus maître de son temps, on peut alors choisir les localités convenables, y demeurer davantage, et ne négliger aucune des circonstances propres à faciliter les travaux, aucune des précautions qui en garantissent l'exactitude"
—Henri Milne-Edwards, Jean-Victor Audouin (1828)[1]

In mid-June 1841, the naturalist Armand de Quatrefages (1810–1892) lit out for the coast. Quatrefages had begun his research in Paris on the microscopic organisms he collected in the garden basins of Versailles, the ponds of suburban Plessis-Piquet, and even the standing water in the ruts left in the road by wagon wheels.[2] Desirous to study the

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[1] The image of "la route peu frayée" comes from Milne-Edwards, "Notices sur la Vie et les Travaux de Victor Audouin," *Mémoires d'Agriculture, d'Économie Rurale et Domestique* vol. 90(1850), p. 379; Henri Milne-Edwards, Jean-Victor Audouin, "Résumé des Recherches sur les Animaux sans vertèbres, faites aux Îles Chausey," *Annales des Sciences Naturelles* t. XV (1828), p. 7.

[2] Armand de Quatrefages, *Souvenirs d'un Naturaliste* (Paris: Charpentier, 1854), I, p. 342.

larger relatives of these lower-order beings, whose simplicity and innate transparency allowed the observer to follow their vital activity in all of its successive stages, he turned his attention to marine invertebrates. He traveled first by stage-coach to Caen, lamenting that the "magical velocity" of the railroad had not yet fulfilled its promise of collapsing the distance between Paris and the coast. From that provincial capital he proceeded to the port town of Granville, where he first "made an acquaintance with the ocean." There, the dramatic tides revealed to the naturalist the alien territory of the sea's floor and the vast array of bizarre organisms stranded there during the low tide (figs. 1.1–2). After being ferried on a coast guard ship to the Grand-Ile of the Chausey Islands, its surface barely equal to that of the Jardin des Plantes in Paris, Quatrefages unpacked his bottles, his instruments, and a straw mattress in a borrowed room of a dilapidated farm house, the island's sole permanent habitation, and set to work.

In fact, Quatrefages was faithfully following an itinerary that zoologist Henri Milne-Edwards (1800–85) and his friend and colleague, the entomologist Jean-Victor Audouin (1797–41) established a decade before in their *Recherches pour Servir à l'Histoire Naturelle du Littoral de la France* (1832–34). A richly composite text, the two-volume *Recherches* was an account of the three voyages they undertook along the coast of Normandy and the Channel, between 1826–29. In it the authors presented not only the zoology, anatomy, and physiology of marine fauna, but the history, topography, and economy a whole tableau of seaboard life. Unlike the great scientific circumnavigations of the period, against which Milne-Edwards and Audouin compared their own efforts, the *Recherches* was the product of punctual visits to a native shore; it was intended to provide the basis for an intensive survey of the French littoral. But it accomplished a goal beyond that of recording and analyzing what the two naturalists surveyed. The book described the *mise-en-scène* of a possible science at the sea, one in which the coast and its inhabitants figure both as a place of study and as an object of study.

Their voyages were prompted by the belief that the natural history museum, the very embodiment of classificatory order, was a distorted optic through which to view nature. Milne-Edwards and Audouin envisioned a different, extramural science:

> C'est n'est donc pas au milieu des collections et dans le silence du cabinet qu'on peut entreprendre un travail semblable; pour l'exécuter convenablement, il faut transporter sur les lieux que ces espèces habitent, et les observer à l'état de vie.[3]

The image of silence perfectly captures the dual aspect of a place devoted to the studied attention of objects in a state of static repose. As more than one naturalist noted, the museum presented a still-life instead of a living tableau. In transporting themselves to the edge of the sea, Milne-Edwards and Audouin were able to observe living nature amid its vital milieu. But in doing so they also exposed themselves to the epistemological (and personal) perils of unbounded space.

In order to understand what was at stake in Milne-Edwards's and Audouin's polemic, it is essential first to understand that an epistemological space had opened up between nature-at-large and the confines of the museum. That space was defined by the very career of the famed comparative anatomist Georges Cuvier, who was at once their principal predecessor at the shore as well as someone who was virtually identified with the activities of the museum. It was a space occupied by a group of collecting-naturalists, who were considered lesser authorities of nature by the scholar-naturalists of the museum who sent them on errands into the field. The respective status of the two types of naturalists ultimately depended on whether these errands were considered a form of service or were the

3 Henri Milne-Edwards, Victor Audouin, *Recherches pour servir a l'histoire naturelle de la France ou recueil de mémoires sur l'anatomie, la physiologie, la classification et les mœurs des animaux de nos côtes* (Paris: Crochard, 1832), I, p. ii.

actual business on which an attentive observer was dispatched.[4] In reclaiming this space by working along shore, Milne-Edwards and Audouin in some sense corrected the course of Cuvier's career while redirecting the French life sciences.

In late summer 1826, Milne-Edwards and Audouin left Paris and set out for Caen and then, after several days making preparations in that city, continued to the Norman port town Granville. Their choice was motivated by the considerable tides in the region, among the most dramatic along the littoral of France. In initiating research along the coast, they retraced a "thoroughly French tradition" which went back a century at least to 1741, when Bernard de Jussieu and Jean-Étienne Guettard were sent by the Académie des Sciences to verify the claims of Jean-André Peyssonel concerning the animal nature of polyps.[5] They believed that the question of the nature of polyps, which touched on the concept of animality itself, would be resolved by bringing the appropriate means of observation to the proper location; in this way, naturalists could effectively focus on an organism whose manner of life was far more determinative of its identity than its plant-like appearance.[6] Milne-Edwards wrote that during de Jussieu's first excursion to the coast, and thus far from the Académie des Sciences, the site of the debate, he convinced himself of the truth of Peyssonel's opinion.[7] Yet the region takes its place in the annals of science with the arrival

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[4] The notion presented her of an errand as such derives from Perry Miller, *Errand into the Wilderness* (Cambridge: Harvard University Press, 1956), p. 3.

[5] Armand De Quatrefages, "Obsèques de M. H. Milne-Edwards," *Discours Prononcés aux Obsèques de M. H.-Milne Edwards* (Paris: Gauthier-Villars, n.d. [1886]),p. 7.

[6] See John Lorch, "The History of Theories on the Nature of Corals," Vie et Milieu, Suppl. 19, *Colloque sur l'Histoire de la Biologie Marine* (1965), pp. 337–345.

[7] Henri-Milne Edwards, "Recherches Anatomiques, Physiologiques et Zoologiques sur les Eschares," in *Recherches Anatomiques, Physiologiques et Zoologiques sur les Polypes* (Paris: Crochard, 1838), p. 3.

of the young Cuvier in August of 1788 to serve as the tutor in the house of the d'Héricy family.

Milne-Edwards's own student Henri de Lacaze-Duthiers, representing the second generation of our narrative, stressed the importance of Cuvier's stay in Normandy, claiming that his works which so profoundly modified zoology at the beginning of the century owed their success to the "conditions where they were done."[8] Milne-Edwards and Lacaze-Duthiers alike were "proselytes" of the practice Cuvier initiated of transporting himself to the site of living nature. For in addition to their town house in Caen, the d'Héricys owned a château at Fiquainville, near Fécamp. Cuvier wrote of the house, "je serai tout à fait naturaliste; c'est une très-agréable résidence, dans un pays boisé et montagneux, à une lieue seulement de la mer."[9] The unusual agreement of the place was owed to the proximity of the sea and wooded areas surrounding the house which were ripe for herborizing. At first alternating between the two residences, in 1791 the family permanently removed itself to Fiquainville, to distance itself from the turmoil of the Revolution.

There Cuvier recorded and described many species of flowers, insects, birds, fish, and marine invertebrates in a series of notebooks he called his "Diaria zoologica." One of these, which eventually served as his entree into the professorial ranks of the Jardin des Plantes, was devoted to "Les Crustacés Comestibles des Côtes de France" (1788).[10] As his correspondent Charles Pfaff predicted, it was his situation near the coast that enabled Cuvier to work directly with invertebrates and to perfect his ideas concerning the animal

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[8] Lacaze-Duthiers, "Discours de M. Lacaze-Duthiers," *Discours Prononcés aux Obsèques de M. H.-Milne Edwards* (Paris: Gauthier-Villars, n.d. [1886]), p. 17.

[9] Cuvier letter to Pfaff, (Caen, February 19, 1791) in *Lettres de Georges Cuvier à C. M. Pfaff 1788–1792*, trans. from German by Louis Marchand (Paris: Victor Masson, 1858), p. 227.

[10] Georges Petit, Jean Théodoridès, "Les Cahiers de Notes Zoologiques de G. Cuvier (*Diaria zoologica*)," *Biologie Médicale* (March 1961), pp.XVII.

economy. He put his anatomical skills to use on organisms that were at once difficult to observe while living, but that upon death immediately become disfigured and almost unrecognizable to the unpracticed observer.[11] Often he placed the animals under water as he worked on them so that their inner cavities did not collapse.[12] The result of his studies of invertebrate circulation was a major revision to imprecise classes of so-called worms established by Linnaeus.[13] Milne-Edwards and Audouin's first trip to the coast was motivated by the desire to confirm what Cuvier wrote about these invertebrate's circulatory system in his epochal *Tableau Élémentaire* (1798).

Yet it would be wrong to interpret Cuvier's stay in Normandy as a simple paean to field studies. His letters to Pfaff convey his longing for scientific society as well as access to a natural history cabinet and botanical garden. In Caen he eventually arranged to make use of the extensive botanical garden and hothouse belonging to the grandfather of his tutee. He also negotiated to visit a natural history cabinet of a local collector.[14] In anticipation of his return to the country after an intense work period in Caen, he wrote to Pfaff "je me rapprocherai de la mer, il est vrai; mais il est cependant dur de quitter un cabinet d'histoire

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[11] Georges Cuvier, "Mémoire Sur le Genre Tritonia, avec la Description et l'Anatomie d'une Espèce Nouvelle, Tritonia Hombergii," *Mémoires Pour Servir à l'Histoire et à l'Anatomie des Mollusques* (Paris: Deterville, 1817), p. 1.

[12] For a discussion of Cuvier's technique as a zoologist, see Henri Daudin, *Cuvier et Lamarck, Les Classes Zoologiques et l'idée de série animale* (1790–1930) (Paris: Félix Alcan, 1926), pp. 89–102; William Coleman, "Les Organismes Marins et l'Anatomie Comparée dite Expérimentale: l'Oeuvre de Georges Cuvier," in *Vie et Milieu* supplément no. 19 (1965), pp. 225–38.

[13] "Mémoire sur la structuree interne et externe et sur les affinités des animaux auxquels on a donné le nom de vers: lu à la Société d'Histoire Naturelle le 21 floréal de l'an 3," *La Décade Philosophique* V (1795), pp. 145–55; for a discussion of the laws of the subordination of characters and correlation of parts see, William Coleman, *Georges Cuvier, Zoologist* (Cambridge: Harvard University Press, 1964), chaps. III, IV; A. J. Cain, "Deductive and Inductive Methods in Post-Linnaean Taxonomy," *Proceedings of the Linnaean Society of London,* 170 (1957–58), 185–217.

[14] Cuvier letter to Pfaff (Caen, September 10, 1788), p. 54

naturelle et un jardin botanique..."[15] The enthusiasm he first experienced at witnessing the dramatic tides was balanced by his longing for the "resources" which would allow him to occupy himself continually with objects of study.[16] His valet, whom he identified as a black man and an able shot, assisted him in catching birds. The fish vendors in Caen and Fiquainville set aside for him unusual (and un-marketable) species. But a previously established collection, the result of such efforts, allowed him to have before him any specimen he wished to study, even those which were not indigenous to the region.

Henri Daudin has argued that Cuvier himself underwent a transformation when his career took him from the "conditions" which proved so important for his early research to the Jardin des Plantes, or the Muséum d'Histoire Naturelle as it was renamed during the Revolution. Though the collections of his famed Gallery of Comparative Anatomy served as the basis for countless scientific paper, at the Muséum he became "bien éloigné par ses fonctions et par ses habitudes des lieux où de pareilles observations séraient possibles et du genre d'activité qu'elle réclament."[17] With his "conquest of the city," as Dorinda Outram has aptly described it, he became "permanently stationary."[18] Thus the willingness to decamp for the shore was stalled until the next generation recognized its value. When his official duties took him to Italy in 1809–10, it afforded him an increasingly rare opportunity to study living specimens in their native habitat. The experience led to an effort on his part to rectify the "chaos of synonymy" which crept into natural history. Synonymy occurred

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15 Cuvier letter to Pfaff (Caen, June, 25, 1790), p. 172.

16 Cuvier letter to Pfaff (Caen, June 25, 1790); (Caen February 18, 1790), p. 146.

17 Henri Daudin, *Cuvier et Lamarck, Les Classes Zoologiques et l'Idée de Série Animale* (1790–1830), p. 98.

18 Letter to Fabbroni (n.d. [1803]), quoted in Dorinda Outram, *Georges Cuvier: Science, Authority, and Vocation in Post-Revolutionary France* (Manchester: Manchester University Press, 1984), p 67.

when two naturalists, unaware or uncomprehending of each other's work, assigned different names to the same species. Natural history had periods of accumulation and of criticism, he wrote, and at the moment it was less important to add to the list of known species than it was to "disentangle" the confusion between those which had already been described.[19] Such clarification, however, took place between the space of collections and written works of reference. Cuvier, who had once shuttled between Caen and Fiquainville, the cabinet and the sea, came to personify the gap which opened between the "observer" who collected specimens in the field and the "classifier" who was content to work on specimens collected by others. If his official duties made him unable to work in the field, he was also increasingly unwilling to do so.

For Cuvier, as Outram has discussed, open space posed an epistemological threat. In his efforts to elevate the status of natural history vis à vis the "exact sciences," the uncertainty of field work meant that the results of the naturalist were subject to any number of variables. The labors of the traveling naturalist were by definition the product of movement. Paradoxically, Cuvier could understand the ensemble of nature only by placing himself bodily at a distance from nature.[20] The cabinet to which he confined himself was a mechanism for viewing, similar to the dirigible and submarine which would appear in the realms of scientific fact and fiction as ideal vantage points by which to scan the entirety of nature. It was an ordered, a visual, even a grammatical space which the naturalist could

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[19] Georges Cuvier, "Notices sur un poisson célèbre, et cependant presque inconnu des auteurs systématiques, appelé sur nos côtes de l'Océan, Aigle ou Maigre, et sur celles de la Méditerranée, Umbra, Fegaro et Poisson Royal; avec une description abrégée de sa vessie natatoire," *Mémoires du Muséum d'histoire naturelle*, 1 (1815), p. 1.

[20] Dorinda Outram, "New Spaces in Natural History," in N. Jardine, J. A. Secord, E. C. Spary, eds., *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996), p. 260; see also the important discussion of "Humboldtian science," in Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Dawson and Science History Publications, 1978), chap. 3.

occupy without the peril of misstatement. In his paper on synonymy, Cuvier explained his own earlier mis-identification of a species by the fact that he was traveling and was without his books.[21] Being in the field, in the very face of nature, came to mean being deprived of one's intellectual resources. Things simply had to be judged on the spot.

Yet natural history could not simply confine itself to the four walls of the cabinet. As Jules Janin wrote in his book on the Muséum, above all else it must open itself to outside. Thus the traveling naturalist (*naturaliste-voyageur*) served as the Muséum's "deputy," dispatched to all latitudes "ramassant, recueillant, entassant dans sa lourde valise, dans son immense herbier les minéraux et les plantes, les poissons de la mer et les oiseaux du ciel."[22] As the "metropolis of science," the Muséum was the store and show place for all the specimens he brought back from the field for the benefit of its resident naturalists. Janin wrote that the same deputies who heroically underwent suffering and sacrifice in the name of science (if not also an assertion of their own manliness) were merely on an errand for the so-called grand naturalist who remained safely within the confines of the Muséum. The traveling naturalists were barely welcome in the establishment whose collections they furnished. Their advice was rarely sought, their authority counted for little. Cuvier was especially careful to distinguish the observations made by traveling naturalists, shaped by any number of untoward experiences. For example, in discussing a group of specimens collected by François Péron "at great danger at the other extremity of the globe," Cuvier limited himself to observation made by himself in his own cabinet.[23] This division of labor, which corresponded to the staggered status of the fixed and traveling naturalists as

21 Georges Cuvier, "Notices sur un Poisson Célèbre," p. 8.

22 Jules Janin, Pierre Boitard, *Le Jardin des Plantes, Description et Mœurs des Mannifères de la Ménagerie et du Muséum d'Hisotire Naturelle* (Paris: J. J. Dubochet, 1842), p. 22–23.

23 Georges Cuvier, "Mémoire sur le Genre Doris," in *Mémoires pour Servir à l'Histoire et à l'Anatomie des Mollusques* (Paris: Deterville, 1817), p. 6.

observers, was reflected in spatial terms: the naturalist's work takes place in the "here," in the cabinet, while the traveling naturalist moves through an imprecise "elsewhere."

How effective was the Museum at making sense of what was sent back from the field, even a generation later? As he compiled his *Histoire Naturelle des Crustacés* (1834–1840), Milne-Edwards made continual use of the Muséum's rich collections which, as he noted, were the fruit of a multitude of distant voyages.[24] The collection was made available to him by Audouin, who, as the chair of entomology, like all of the professors, also served as an administrator of the institution. In that capacity, in addition to his role as a researcher, he was responsible for the growth and conservation of the collections entrusted to him.[25] But Milne-Edwards despaired of the state of the collections. Despite the detailed instructions given to traveling naturalists about properly labeling and packing their specimens, as well as the great care taken in transporting them from port to Paris, they were as often as not misplaced once they entered the Museum. Milne-Edwards complained that the specimens Péron and Charles Lesueur sent back from their celebrated voyage to Australia, which Lamarck had been responsible for arranging, were all marked with the same label, no matter "the real locality" they came from."[26] Many of the specimens which figured in his *Histoire Naturelle des Crustacés* had been sitting unexamined for years in the Muséum's storage rooms.[27] Though there were vivid debates throughout the century on the ordering system to be used in the public displays of specimens, during this same period the

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[24] Henri-Milne Edwards, *Histoire Naturelle des Crustacés* (Paris: Librairie Encyclopédique de Roret, 1834), I, p. xxxi.

[25] Henri-Milne-Edwards, "Notice sur la Vie et les Travaux de Victor Audouin," p. 382.

[26] Milne-Edwards, "Recherches Anatomiques, Physiologiques et Zoologiques sur les Eschares," *Annales des Sciences Naturelles* (Fevriér 23, 1835), p. 41.

[27] Henri Milne-Edwards, *Histoire naturelle des Crustacés* (Paris: Librairie Encyclopédique de Roret, 1834), I, p. xxxii.

amount of un-sorted material stored in attics, hallways, and drawers grew. Part of the solution for the Muséum was literally to expand with the construction of new galleries and laboratories. But for Milne-Edwards and Audouin, more was at stake than a chronic shortage of built space.

Not only did working in the cabinet put the naturalist at a distance from the field, but the museum-based naturalist's reliance on his deputies to be his hands and eyes in the field ran the risk of introducing the purported disorder of the latter into the ordered space of the former. With the naturalist's confinement to his cabinet, increasingly all that he was able to know was that cabinet. As Quatrefages wrote, the naturalists who could only speak about an animal's place in a system of nomenclature did not deserve that title any more than the clerk who knows the title and call number of every book in the library deserves the title savant.[28] To be sure, Cuvier brought a great deal of insight into the arrangement of his Gallery of Comparative Anatomy. But Cuvier subsequently became bound to that ordered setting.

Audouin and then Milne-Edwards, who assumed the chair of entomology after Audouin's untimely death in 1841, sought to arrange their collections according to the natural method, the order of nature itself. But at the same time, Milne-Edwards claimed that the very project for which the Muséum was the privileged site, that of producing a synthetic tableau of nature, had itself come to its natural end. The great catalogue of nature, he wrote, had been roughed out in all its various parts. And while traveling naturalists had contributed materially to the progress of natural history, the field of natural history itself needed to change:

> les travaux des collecteurs ont perdu de leur importance et les naturalistes ont compris qu'il fallait chercher désormais à approfondir leur science plutôt qu'à en

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[28] Quatrefages, *Souvenirs d'Un Naturaliste*, I, p. 58.

> étendre la superfice; laissant donc à autres mains le soin de rassembler les objets qu'ils avaient encore à inventorier, ils se sont attachés à l'étude de la nature intime des êtres dont les formes extérieures avaient jusqu'alors absorbé presque toute leur attention.[29]

Milne-Edwards equates the redirected perspective of the naturalist with a new spatial and epistemological horizon. The problem was not any longer to be one of scanning the surface of nature, accumulating collections, overcoming great distances, but rather studying things in depth, which would involve tracking a being's vital functioning over time.

And, perhaps most significantly, the task was no longer that of collecting specimens and bringing them back to a convenient place of study. Rather it was to witness, even to intercept, an organism's exchanges with its vital milieu. From this fact stems the second aspect of Milne-Edwards's and Audouin's critique of cabinet-based science. The marine specimens which furnished it gave no indication of their vital functions.[30] One had to be content with the dried remains of animals, or conduct dissections on beings which were deformed, discolored, and distorted by the fluids used to conserve them. What Bernandin de Saint-Pierre wrote at the time of the reorganization of the Jardin des Plantes during the Revolution held true for much of the nineteenth century: its collections represented "la nature morte: des fossiles; des herbiers; des animaux disséqués, empaillés, injectés."[31] Instead of unpacking the "great valises" and herbaria hauled back by traveling naturalists,

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29 Milne-Edwards, "Recherches Zoologiques Faites Pendant Un Voyage sur les Cotes de la Sicile," p. 1–2.

30 Henri-Milne-Edwards, "Notice sur la Vie et les Travaux de Victor Audouin," p. 382. On advances in taxidermy see, Paul Lawrence Farber, "The Emergence of Taxidermy and the History of Ornithology," *Isis*, 68 (1977), pp. 550–66.

31 Jacques-Henri-Bernardin De Saint-Pierre, "Mémoire sur la nécessité de joindre une ménagerie au jardin des plantes de Paris," *Oeuvres Complètes de Jacques-Henri-Bernardin De Saint-Pierre* (Paris: Méquignon-Marvis, 1818 [1793]), XII, p. 635.

they packed up their instruments and set out to witness nature its living state. Milne-Edwards and Audouin returned to the conditions Cuvier left behind. His move to the Muséum had marked the end of the beginning of his career, the part which Milne-Edwards and Audouin would seek to recuperate through their own efforts as field naturalists. Just as importantly, they renounced the Muséum's mode of producing collections, the voyage of discovery, and instead traveled by stage-coach and then on foot to the shore. They were following, in Milne-Edwards's words, "an unmarked route."[32]

LIVING IN PLACE

In approaching the sea from the land, instead of seeking out distant shores, Milne-Edwards and Audouin equally sought to correct problems posed by ship-based research. Carried out in the name of science wed to commerce and empire, the heroic character of these circumnavigations was one of the defining narrative trajectories of the period.[33] However, Milne-Edwards and Audouin expressed regret that while enlightened governments rivaled each other in subsidizing these "noble enterprises," naturalists were in a state of regrettable ignorance concerning the riches of their own soil.[34] Their comments can also be read in terms of the advantageous conditions for research which were only to be found on one's domestic coast. The problem confronting the naturalist aboard a long distance voyage was a perceptual one: he was a passengers rather than the pilot of the research vessel. The role of pilot was reserved by naval officers whose first priority was the cartographic

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32 Milne-Edwards, "Notice sur la vie et les travaux de Victor-Audouin," p. 379.

33 For a recent discussion see David Philip Miller, "Joseph Banks, empire, and 'centers of calculation,' in late Hanoverian London," in David Philip Miller, Peter Hans Reill, eds., *Visions of Empire, Voyages, botany, and representations of nature* (Cambridge: Cambridge University Press, 1996), pp. 21–37.

34 Milne-Edwards, Audouin, *Recherches*, I, i.

projects for which the ship itself was an important instrument.[35] Indeed, a plan Milne-Edwards devised to establish a research station upon a coral island in the Mediterranean for the span of several years failed when the commander of the French warship which would have serviced it was unwilling to submit to the commands of a naturalist.[36] A brief examination of the zoological account of the voyage of the *Uranie* (1817–1820), written by the highly reputable naturalists, Joseph Paul Gaimard and Jean-René-Constant Quoy, exemplifies the difficulties of the such voyages as a platform for research in anatomy and physiology.[37]

Quoy and Gaimard, both of whom had the medical training which was typical of naturalists who doubled as shipboard physicians, first of all wrote of the bodily dangers posed by working in unaccustomed environments. Short of death, the price to be paid for not taking proper account of these conditions was losing unique opportunities to make observations due to illness.[38] The field of study was itself an occupational hazard. Another serious threat was shipwreck. In fact, on its return journey, the *Uranie* ran aground along the Falkland Islands, causing the naturalists to lose a considerable portion of their collections. They wrote touchingly that if the naturalist of the capital took an interest in debris which had been saved from the disaster they would consider it sufficient compensation for the pain and privations they suffered during their long and perilous

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35 See Richard Sorrenson, "The Ship as Scientific Instrument in the Eighteenth Century," *Osiris* vol. 11 (1986), pp. 221–236.

36 Anton Dohrn, "The Foundation of Zoological Stations," *Nature* vol. V (February 8, 1872), p. 277.

37 For a discussion of seaboard expeditions, see Helen Rozwadowski, "Small World: Forging a Scientific Maritime Culture for Oceanography, *Isis* 87 no. 3 (September 1996), pp. 409–429.

38 Joseph Paul Gaimard, Jean-René-Constant Quoy, Zoologie, volume III of *Louis Freycinet, Voyage autour du monde . . . exécuté sur les corvettes . . . . l'Uranie et la Physicienne, pendant les années 1817, 1818, 1819, 1820* (Paris: Pillet Aîné, 1824), p. 593.

navigation. On their subsequent voyages, they made sure to send back specimens at regular intervals and to make doubles of all the sketches in their portfolio.

In was in the chapter on polyps, the study of which had initiated the French tradition of working at the shore, that the problematic nature of the long distance journey is taken up by Milne-Edwards and Audouin. There Quoy and Gaimard explained that the greatest difficulty they confronted was "the lack of time."[39] Although they spent two months on an island rich in specimens, there were too few instances when conditions were advantageous for observation. To make a proper study of these animals, they wrote, one must have the leisure to wait for the proper moment or season to study them.[40] Indeed, Milne-Edwards and Audouin wrote that while long distance journeys allowed the naturalists to visit a great diversity of locales, the great distances the ship covered meant that the same experience or observation could never be repeated, nor could any single locale be studied in depth.[41] What Quoy and Gaimard identified as a predicament of time was relative to place: they concluded that only a naturalist "living in the places" themselves was in a position to carry out appropriately in-depth observations.[42] In arguing for the investigation of their domestic shore, Milne-Edwards and Audouin were in fact articulating for the first time a plan for living in place. Their own domesticity would be a means of settling on the proper conditions of observation.

In a letter to the Muséum's professors written upon his and Milne-Edwards's second voyage to the coast in 1828, Audouin wrote "cette année nous avons transporté le siège de

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39 Gaimard, Quoy, *Zoologie*, p. 592.

40 Ibid., p. 591.

41 Milne-Edwards, Audouin, *Recherches*, p. ii–iii.

42 Gaimard, Quoy, *Zoologie*, p. 593.

nos observations aux Îles Chausey que nous savions être très riches en animaux marins."[43] The figural "seat" implied a sedentary mode of observation, comparable to the commanding view the manager of a well disposed estate, or *sedes*, has over his lands. The very idea of transporting their seat of observation, however, points to an inherent tension in the mode of research in which they were engaged. The voyage of observation as they conceived it was not defined by transit, but by the successive stations along the coast where they established themselves for a period time. That period was defined by a place's riches in marine animals. The naturalists "settled" on the Chausey Islands; they took possession of the element of time, place, and circumstance which were constitutive of observation. But the arrangement was itself a temporary affair.

The punctual nature of the *Recherches* is made evident in its frontispiece, which does not chart a grand trajectory but is simply a map of the littoral departments Manche and Ile et Vilaine, providing a representative topography. It was but the first regional installment in the naturalists' ultimately unrealized plan to survey the entire littoral. Each subsequent frame, with all its accidents of terrain, was the surface upon which to plot patterns of distribution of life as well as the naturalists' progress and that of the cause of knowledge. But the survey of the coast was not to be a linear process. Nor was it a cycle of accumulation, as Bruno Latour has described the manner in which metropolitan centers became dispatch emissaries in order to become "familiar with things, people and events which are distant."[44] The point of departure of our naturalists' voyages of observation was the cabinet, where the objects and intelligence produced by these expedition was sorted through and calculated. Milne-Edwards and Audouin's project consisted instead of a series

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[43] Jean-Victor Audouin to Messieurs [professors of the Muséum] (September 27, 1828), quoted in Jean Théodorides, *Un zoologiste de l'époque romantique, Jean-Victor Audouin (1794–1841)* (Paris: Bibliothèque nationale, 1978), p. 59–60.

[44] Bruno Latour, *Science in Action* (Cambrige: Harvard University Press, 1987), p. 222.

of epicycles, each centered on point along the periphery. Their research took place and evolved within the frame of the map, over the stretch of the coast which could be covered on foot from their temporary laboratory, between the high and ebb tides. It was not bounded by the silent confines of the cabinet.

Quatrefages, too, felt the conflicting pulls of movement and stasis in conducting research at the coast. Tracing a map of the Chausey Islands with his finger, Quatrefages plotted the "location of his next station."[45] Though his notebooks were filled with "incomplete notes" and his portfolio contained "unfinished drawings," he moved onto the next situation for research where he would set up again a select version of the study he left behind in Paris. The establishment of research stations was not a resolution of the tensions inherent in making observations which were bound to time in place; rather they were structured by them.

Before exploring in the following chapters how Milne-Edwards and Audouin and Quatrefages in their wake conceived of the "seat of observation," and the sense of place it created, it is well to note the "pilgrimage" made in 1924 by the malacologist Gustave Frederic Dollfus to the chateau at Fiquainville where Cuvier carried out his important researches on mollusks. The very term pilgrimage evoked one of the early—but by no means earliest—meanings of the term "station," a stopping point along a devotional route for the transportation of sacred relics. (In antiquity, the term referred to those who were stationed along main routes and given the task of collecting taxes.) Dollfus explained that it was interesting to examine the milieu in which important men had once lived.[46] He found the small room on the first floor which Cuvier had occupied; it had two windows looking out

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[45] Armand de Quatrefages, *Souvenirs d'Un Naturaliste,* I, p. 80.

[46] G[ustave] F[rederic] Dollfus, "Le Séjour de Georges Cuvier en Normandie," *Bulletin de la Société Linnéenne de Normandie,* ser. 7, vol. 8 (1925), p. 156.

onto an open prairie and to the sea in the distance, visible when the weather was clear. Dollfus and his companions attempted to reconstruct the circumstances which gave rise to Cuvier's science. They were not able to determine exactly where he carried out his dissections, or where his collections were kept. What was certain, however, was that the set-up was quite simple and had nothing of the elaborate equipment of "modern" laboratories. In the absence of artifacts, they were left to conclude that his method must have emerged "independent of the installations."[47] The most remarkable feature of the place, he concluded, was the fact that Cuvier daily had access to living nature. Cuvier, whose became indelibly attached to the spaces and indeed the reputation of the Muséum, was formed in a context which left practically no trace of itself.

More than half a century passed following Milne-Edwards's first voyages to the coast before the Museum created a station in the "places themselves" where living nature thrived. By that time, there was no longer any question whether such stations were needed, but merely on what basis they were to be established. The committee of Museum professors which convened in 1881 to study this issue noted in its report that many provincial science faculties near the sea had already established stations in their own right.[48] Having no such annex, as an institution the Museum was in an arrested state. When a plan for a laboratory was finally approved in 1888, Edmond Perrier, its chief promoter, described the Museum in terms which would have been familiar to Milne-Edwards (fig. 1.3). Conceived as the "metropolis of the natural sciences," he wrote, it was instead a "necropolis."[49] His comment did not simply reflect the fact that the Museum's "attics" contained masses of

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47 Ibid., p. 156.

48 Archives Nationales, Series AJ^{15} carton 851.

49 Edmond Perrier, "Le Laboratoire Maritime du Muséum d'Histoire Naturelle," *La Nature* no. 794 (August 18, 1888), p. 186.

unseen specimens. Rather, with the construction of the vast new gallery of natural history which finally expose this material to the light of day and public view, the Museum was turned into a monument of natural history. The impressive stone facade, which enveloped the central iron and glass galleries, was inscribed with the great names of French science—a commemorative stele planted at the end of the botanical garden's long alleys. The gallery were inaugurated in 1889, just as the Museum's research station, which occupied a converted lazaret in the Bay of the Seine, began operation. The significance of the research station, noted one observer, stemmed precisely from the fact that it was built beyond the Museum's walls.[50]

In going beyond the Museum's walls, in creating what we can call an extra-mural science, the marine stations in question proved to be anti-monumental. Designed by Jules André, Grand Prix of 1847, the new gallery was regarded in the scientific press as a "majestic monument, a palace."[51] In praising the imposing character of its noble façade, André's own student, the influential academician Julien Guadet, wrote of it as if it were the Louvre of science.[52] The very comparison ratified the Museum's long-standing roles of displaying nature and of serving as a place for naturalists to live and work. What is at stake, however, is the function of the museum's walls, considered generically as an institutional edifice, in the production of knowledge, and in the shaping of experience. For what is evident in André's design for the gallery is that its status as a monument depended on conserving the meanings inherent in architecture itself. Notably, Daly wrote that André's

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50 Paul Lemoine, "Le Muséum d'Histoire Naturelle," in *Archives du Muséum National d'Histoire Naturelle, Volume du Tricentenaire* (Paris: 1935), p. 18.

51 Gaston Tissandier, "Nouvelles Galeries de Zoologie," *La Nature* no. 354 (October 12, 1889), p. 311.

52 Julien Guadet, "JulesAndré Architecte, Notice sur sa Vie et ses Oeuvres," *Journal de l'Architecture* (June 1890), p. 13.

design recapitulated the development of architecture which was rooted in antiquity and carried forth in time and space to all great modern buildings. André was not an "innovator," but was rather a "conservator" of the classical heritage.[53] The objective of an extra-mural science was not conservation but rather production of new forms of knowledge and the creation of new settings for them; setting aside existing institutional structures was architecturally speaking an innovative act.

It would be incorrect if not somewhat confusing to state that an anti-monumental bias was held by the promoters of marine stations, especially when the efforts they expended in establishing them on a permanent basis are examined. Rather, the historic and material circumstances in which, the marine station emerged as a type offer reasons why the very idea of initiating new construction for the purpose of facilitating research was itself problematic. In addition, if the as yet undefined nature of the marine station as an institution already raised questions with regard to architectural representation, the frequently expressed belief—that anything in a building's design which did not contribute to the ends of research was wasteful—limited the range of expression. This last statement is complicated by the fact that evolving practices of research could only be defined with reference to the structures in which they were carried out. The Museum's own laboratory is a perfect example of a station which occupied a structure built for another purpose, rather than one resulting from a carefully considered design. As the architects of the recent restoration of André's gallery have written: to conserve is to transform.[54] What was conserved in the case of the Museum's laboratory, however, was not the heritage of

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53 Note by César Daly in F. Monmory, "Le Nouveau Muséum d'Histoire Naturelle au Jardin des Plantes de Paris," *Revue Générale de l'Architecture et des Travaux Publics* ser. 4 vol. X (1883), p. 19, no. 2.

54 See Paul Chemetov, "La Memoire et l'Oubli," in *La Grande Galerie du Muséum* (Paris: Le Moniteur, 1994), pp. 92–9.

architecture, but a simple structure which lost its purpose just as that of the laboratory came into its own.

The laboratory occupied a mostly abandoned lazaret and military reservation built by Napoleon III for the troops returning from his adventure in Mexico between 1861–67 (figs. 1.4–5). Théodore Dauphin, André's assistant, was responsible for the relatively minor task of converting the eleven existing buildings to the needs of research, work which primarily consisted of plumbing and rearranging walls.[55] The very cabinets in the station's collection room were salvaged from the old gallery of natural history which André was in the process of replacing. The sense that the naturalists had merely moved in was conveyed by the author of one article who hesitated to describe the buildings, noting that they were conceived for another purpose altogether; the single detail he noted was the stair of the former isolation building which was converted into the central laboratory.[56] In fact, the distinctive element of the assemblage of buildings was its siting. Due to their privileged locations in ports and along the coast, lazarets, barracks, fortifications, even a prison for galley slaves were seen as desirable sites for research stations.[57] When there was no threat of a quarantine or a change in military deployments, these sites represented a stock of available structures requiring only a change in their official designation. The necessary remoteness of the lazaret proved a favorable circumstance for naturalists wishing to study the maritime region undisturbed. In these vacated spaces, naturalists from the Muséum were finally able realize Milne-Edwards's program of studying living beings "in place without

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55 Archives Nationales, series AJ^{15} carton 850.

56 A. E. Malard, "Le Laboratoire Maritime du Muséum à l'Ile Tatihou," *Compte Rendus, Congres de l'Associtation Française pour l'Avancement des Sciences, Cherbourgh et le Cotentin* (Cherbourgh: le Maout, 1905), p. 667–688.

57 Barry Bergdoll, "The Architecture of Isolation, M.-R. Penchaud's Quarantine Hospital in the Mediterranean," *AA Files* 14 (1986), p. 5.

changing in any way their mode of existence."[58] The Île Tatihou can be considered typical of a number of stations which were either the product of remodeling or could not be distinguished from strictly utilitarian structures. A number of examples from the 1880s–90s suggest a range of architectural responses to what was by then becoming a familiar building program.

The research station's relationship to its region, a category charged with geographic, cultural, even eidetic meanings, is clearly to be seen at Endoume (figs. 1.6–7). The station began functioning in a couple of small rooms in Marseille's science faculty, located in a dense urban quarter distant from the port, before moving to Endoume, a suburb connected to the center city by the Corniche, the famed scenic road which traced the line of the coast. The station's founder, Antoine-Fortuné Marion, professor in zoology and director of the city's museum of natural history, emphasized the intimate liaison between the place and the object of research.[59] The mathematician, he explained, can do his work without any regard to the "ambient milieu." Physicists and chemists could detach themselves from "external influences." The observational sciences, however, were by nature an "expression" of the region where they were pursued. [60] The naturalist's work revealed the contours of place, its varying aspect. Marion's own intellectual formation was very much a product of place. He belonged to the extraordinary circle of friends, including Paul Cézanne, Emile Zola, and the critic Antoine Valabrègue, who attended the Collège Bourbon in Aix-en-Provence. Their youthful occupation was captured in Cézanne's "Marion and Valabrègue Setting out for the

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58 Milne-Edwards, "Recherches Zoologiques Faites Pendant un Voyage sur les Côtes de la Sicile," p. 4.

59 This is clearly evident in his "Esquisse d'une Topographie Zoologique du Golfe de Marseille," *Annales du Musée d'Histoire Naturelle de Marseille* t. 1 (1883), which won the Grand Prix des Sciences Physiques given by the Académie des Sciences (1884).

60 Antoine Marion, "Avertissement," *Annales du Musée d'Histoire Naturelle de Marseille, Zoologie* t. I (1883), p. VI.

Motif"(1866). The subject matter of the oil-sketch was a statement of his new open-air approach to painting: Marion appears wearing a Barbizon hat and an easel strapped to his back.[61] The "motif" of the title referred to "a landscape of course," as Cézanne explained in a letter to Zola. What working in the open-air meant to a painter and to a naturalist was different, of course, as was the respective role of the laboratory and studio. Marion literally "set out for the motif," receiving funds from the minister of public education to the study the principle research stations in Europe to ensure the best arrangement of his own laboratory.[62]

The epistemological conditions Marion defined with regard to research resonated with contemporary efforts to promote regional architecture through familiarity with its "ambient milieu," its "motifs." Having trained at the École des Beaux Arts in Paris on a fellowship from the city of Marseille, the architect of the station at Endoume, Ernest-Pierre Paugoy, was nonetheless one of the founders of the Association Provinciale des Architectes Français.[63] The Association sought not only to uphold the professional prerogatives of its members but to preserve the underlying character of regional architecture. As one of the its members argued in an important address, if works of architecture were to be Bourguignons, Normands, or Poitevins, etc., they could not simply be handed to the architects trained in Paris who were given regional postings. On the contrary, the architect needed to have a deep understanding of the place—its traditions, local materials, the mores, the climate."[64]

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61 See Lawrence Gowing, *Cezanne The Early Years 1859–1872* (New York: Harry N. Abrams 1988), p. 120.

62 Archives Nationales, series F^{17} carton 2988. Marion's itinerary incuded: Banyuls, Roscoff, Concarneau, Boulogne, Plymouth, Alger, Trieste, and Sebastopol.

63 *Les Bouches du Rhone, Encyclopédie Départementale* (Marseille, Archives Départementales des Bouches-du-Rhone, 1914), p. 493.

64 Lucien Lefort, "De la Décentralisation dans l'Enseignement Pratique de 'Architecture," *L'Architecture* (August 3, 1889), p. 458.

This knowledge could not be gained "at a distance," nor simply from books. For the architect's work to be imbued with the "particularism of art," it was indispensable for him "to reside amid the milieu where he works." The statement is notable for how closely it resembles the mode of observation called for by naturalists. The commonality of sentiment, however, did not result in a coherent approach by architects to the design of research stations which allowed naturalists "to reside amid the milieu where they worked." Part of this was due to an untenable choice between the compositional techniques of the École and the anachronism of naive regionalism. In the case of Marseille, as will be discussed presently, it was also an issue of local politics.

The fact that Paugoy's was the only design for a research station to figure in an architectural journal, in addition to being included in the Paris Salon of 1886, evidently had less to do with its regional accents, however, than with its "originality." That was the term used by Daly to congratulate Paugoy's entry, commenting on what a rare thing it was in those days.[65] The most prominent and original feature of the design was its tower—round at its base, which flared outward with dramatic squinches, surmounted by a two-level gallery and look-out. The building certainly did not suffer from the "banal character" so often given to scientific or school buildings.[66] Its profile was further accentuated by a large roof-terrace covered by a velarium. In fact, the roof-terrace belonged to Marion's apartment, which occupied the third floor. The scientific monument Marion conceived, which was at the same time his home, was a step toward creating a University of Provence, while providing a commanding view of the region's defining features, the mountains and the sea. Creating a research station meant rivaling Montpellier, Nancy, Lyon, Toulouse, Bordeaux,

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65 César Daly, "Salon de 1886," *Revue Générale de l'Architecture et des Travaux Publics* vol. XLIII (1886), p. 91.

66 R., "Laboratoire de Zoologie Marine a Endoume," *La Construction Moderne* (December 4, 1886), p. 88.

Cette, Nice, and Cannes, in their claims to being "scientific cities." Indeed, he explained that his choice to remain in Provence, even after being called to Paris to replace Milne-Edwards at the Sorbonne, stemmed from his desire to create in Marseille a "scientific monument."[67]

The failure of Paugoy's design to be fully realized resulted from diminished municipal support for such a monument, and the politically motivated perception that its architecture was "voluptuary." Ironically, Marion's long-standing engagement in the cultural affairs of Marseille worked against him when a number of his professional enemies, including the person he replaced as director of the museum, were elected to the municipal council. The construction of the station which began with enthusiastic municipal support came to a halt in 1884; three years later, Marion's student Paul Gourret wrote of the "unformed laboratory left exposed to all the elements."[68] The new municipal administration claimed that changes had been made to the design of the tower "in an absolutely voluptuary intent."[69] There followed protracted legal haggling over the estimating process, but construction only resumed when Gourret himself was elected to the municipal council in 1887.[70] The good faith Gourret offered to the municipal council took the form of limiting the station's architectural pretensions. As newly conceived, the laboratory was to be "simple commode, bien éclairé, propre en un mot au rôle qu'il est destiné à remplir, et non pas d'élever un monument pour lequel les exigences de l'architecte

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67 Marion letter to Gaston Saporta (July 17, 1885), quoted in Georges Reynaud, Jean Beurois, "Antoine-Fortuné Marion (1846–1900), Initiateur de l'Océanographie à Marseille," *Marseille* 163 (May 1992), pp. 37, note. 30.

68 Paul Gourret, "Rapport présenté au nom de la commission des travaux, sur l'Achèvement de la Station Zoologique d'Endoume," *Annales du Musée d'Histoire Naturelle de Marseille* t. III (1886–1889), p. xiv.

69 Ibid., p. xi.

70 Archives Municipales, Marseille, series 105-M.

primeraient et sacrifieraient celles de la science."[71] He went on to argue that the changes to Paugoy's original design, which sparked the controversy, involved suppressing ornamentation. The unfortunate process of depriving the edifice of its architectural accouterment nonetheless revealed an underlying notion central to the conception of marine stations: in the words of Gourret, a "sage economy."

The port town of Cette, twenty miles to the west of Marseille, had somewhat more success in creating a municipal monument (figs. 1.8–9). Belonging to the science faculty of the University of Montpellier, the station was situated at the opening of the Canal de la Bordique, which connected a large coastal lagoon to the sea. In endowing Cette with such an institution, its founder Armand Sabatier spoke of offering its citizens a "hidden treasure and buried ornament": the beings living in its canals, its lagoon, and by the sea.[72] The likeness of some these beings would be carved into the capitals of the laboratory's pilasters. Having followed what will be seen as a familiar pattern of making-do in places ranging from a fishermen's house to a room in a high school, Sabatier promoted the idea of making the station a permanent structure. In a series of public talks, he set about interesting the business-minded citizens of Cette in what Adolphe Thiers referred to as the "affairs of the mind."[73] The result was a building which was indeed an intellectual ornament to the city. Dressed up in familiar classical form, it was at Cette that the laboratory took on recognizable—that is, monumental—form as an institution.

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71 Paul Gourret, "Rapport présenté au nom de la commission des travaux, sur l'Achèvement de la Station Zoologique d'Endoume," p. xvii.

72 Armand Sabatier, "Le Laboratoire de la Station zoologique de Cette," *Bulletin de la société Languedocienne de Géographie* (Juin 1882), p. 2.

73 Henri de Varigny, "La Sation Zoologique de Cette," *Revue Scientifique* 10 (May 8, 1886), p. 596.

The municipal architect of Montpellier to whom the design was entrusted based his plans on the indications Sabatier gave him of research stations at Marseille, Trieste, Banyuls and above all Naples. Like Marion, Sabatier had conducted a tour of existing laboratories to study of the proper installation to give his own; research stations were themselves become points of quasi-scientific interest. The building consisted of two flanking pavilions connected by a central corps resting on an ashlar base housing a museum, with individual rooms for researchers on the upper floor. Despite the casual detail of its pilasters, the building clearly falls within the countless city halls, prefectures, hospitals and other civic institutions at which architects in the state employ excelled. So much so, that one observer noted that the building had "nothing architectural nor luxurious" to it, even if the masonry cost a great deal.[74] To be sure, its institutional identity could literally be read on its facade, in the large "Station Zoologique" inscribed along its cornice, or in the smaller marble plaque over the entry portico inscription in gold lettering. As will be discussed below, for Henri de Lacaze-Duthiers, who founded two of the most important research stations in France, gold lettering was emblematic of architectural pretension which placed appearances before comfort.

The function of the station, as opposed to its institutional identity, was more readily legible in its situation than in its decorative scheme; in fact, Cette was the only research station to *have* what might be called a decorative scheme. The uniqueness of its situation stemmed from the fact that it occupied a site where the canal brought together the two distinct environments of the sea and the lagoon. This "variety of milieux" made it possible for researchers to observe the subtle modifications produced by the movement between the

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[74] A. Gruvel, "Sur Quelques Stations Zoologiques de la Méditerranée," *Mémoires de la Société des Sciences Physiques et Naturelles de Bourdeaux* ser. 5, t. V (1901), p. 34.

two environments.[75] The large aquarium in the station's basement could be considered a third environment, created by the naturalists to reveal what was "hidden" and "buried" in these bodies of water. The public had access to these treasures in the museum, where every effort was made to create an "agreeable" space. A series of armoires filled with specimens and artifacts of the fishing industry and oceanography lined the walls, forming a pedagogic "promenade." On the upper floor, in the communal research room, two large canvases depicted the working hours of the naturalists. The two views of Cette, one at morning and the other at dusk, both seen from the sea, flanked the doorway leading to the library, above which was written in gold letters Sabatier's motto: "Partout est la Vie." In the morning scene, a young boy with his pants rolled up stands in the shallow water collecting sea urchins.[76] In the painting, the water's surface is agitated and dappled with color and light, and with this simple act of gathering from the sea, the station's daily work begins. As Sabatier described it: "everyone sets himself up as his work table, arranges his microscope, his drawing paper, his instruments of dissection, and thus the hive makes itself active until lunch time."[77] Then, at the end of the day, the researcher seeks a bit of repose in his own room.

The case of the research station at Wimereux is revealing in that it involved the efforts of a noted architect in the direct employ of a naturalist, with results which were decidedly other than monumental. Remaining true to the form of the station, Wimereux was in essence a house at the shore. The architect was Louis Bonnier, whose reputation as a stylistic innovator was made early on with his decorative work for Siegfried Bing's influential Art Nouveau gallery in Paris. The naturalist was Alfred Giard, an outspoken

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75 Henri de Varigny, "La Sation Zoologique de Cette," p. 596.

76 The paintings were by Michel-Maximilien Leenhardt and Fernand Balaman.

77 Armand Sabatier, "Laboratoire de la Station Zoologique de Cette," p. 8.

man of progressive views in politics and staunch in his advocacy of evolution. The two met through the architect's brother Jules Bonnier, a naturalist who collaborated with Giard for years in the rented chalet which served as the initial site for the station. At Wimereux, for the first time, it is possible to speak of an architect addressing the program of the marine station, as opposed to simply providing a building or remodeling an existing one. Giard's needs were revealing in this regard. As one observer noted: "Work was his sole occupation. A chair, a laboratory, instruments, he asked for nothing more. All the rest was without importance—except the happiness of the hearth" (*le bonheur du foyer*).[78] In instances seen already, finesse of design was considered along with what Giard referred to as all the rest, namely that which was extrinsic to the naturalist's occupations. Cette was a singular example where the paintings distilled its essence. Of fundamental importance, then, is the inclusion of the "happiness of the hearth" with what is essential, beginning with the element of the chair. In the chapters that follow, the notion of the foyer will be given significance with regard to defining the naturalist's occupations.

Bonnier's own interest in the foyer is evident in the grouping of beach houses he built at Ambleuteuse, on the dramatically broad sandy beaches of the north of France, the site of Giard's original station. Influenced by his reading of Viollet-le-Duc and books on English domestic architecture, Bonnier created vacation villas which were at once rustic, rational, economical, and above all comfortable.[79] They contributed to the "balneal" (literally, bathing resort) style which emerged in the 1890s as a non-monumental form of Art Nouveau (figs. 1.10–12). The object of the design was to be perfectly adapted to its situation.[80]

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[78] Henry de Varigny, "La Nature et la Vie, Alfred Giard," *Le Temps* (September 2, 1908).

[79] Bernard Marrey, *Louis Bonnier* (Paris: Mardaga, 1988), p. 17.

[80] François Loyer, "France," in Frank Russell ed., *Art Nouveau Architecture* (New York: Rizzoli, 1979), p. 130.

Built into the side of a protective dune, Wimereux was designed in a similar vein. The laboratory wing occupied the longer wing of the L-shaped gabled structure; the other was formed by separated but adjoining houses for Giard and the station's caretaker. The various public and private spaces which joined in making the station were expressed in a picturesque manner on the façade and roof line.

His design also extended to the station's furniture. To anticipate the discussion which will follow on the original portability of research stations, what is striking is that everything is built-in (fig. 1.13). The construction of partitions, tables, and shelves in the central research room are integrated into the framing of the building envelope and reflect its geometry. These basic element afforded each researcher "identical" conditions of work while permitting total communication between the researchers.[81] In communal rooms such as the library, a fireplace is situated in the center of two bays of bookshelves; above it was a portrait bust of Darwin. Bonnier's command of the intimate details connecting the structure to the life of the station extended to the researcher's bedrooms under the gables, where the roof beams served as the supports for small desks. Bonnier provided an agreeable setting where, given the nature of the occupation in which they were engaged which required them to be by the sea, researchers enjoyed all the trappings of home.

An earlier scheme drawn by Bonnier, however, is evidence of his thinking about an altogether original form for the research station. Though its articulated wood framing and the brick detailing of its central hearth are clearly derived from his beach villas, the proposal is new in its conception. The researcher's desks have been shifted to the perimeter of the circular room, the window bays in front of them spaced apart by a panel of neatly arranged specimen jars. An inner ring offers continuous circulation and intellectual exchange

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81 Alfred Giard, "La Station Zoologiques de Wimereux de 1874 à 1899," in Alfred Giard, *Oeuvres Diverses* (Paris: Laboratoire d'Évolution des Êtres Organisés, 1913), II, p. 86.

throughout the station. The fan-vaulted roof sits atop clerestory windows, below which are inset panels inscribed with the names of the philosophers of evolution and morphology: Goethe, Von Baer, C. Woolff, G. S Hilaire Haeckel, Lamarck, Darwin. Giard spoke of his wish to spread their ideas and ultimately bring about a "revolution" in the biological sciences.[82] The sectional view of Bonnier's drawing seems to be present an object lesson in the building's own structural logic: *You carry and I am carried, you assemble and I am assembled . . .*[83] But the didacticism of a circular structure as a foyer for the study of evolution is clear. The foyer, in the multiple sense of a point of gathering and center of origin, and a literal fireplace, is the fulcrum for the expansive views which open out from the perimeter of the annular structure. The vivid experiment in form evident in the study would have no place in any station build in France built by Bonnier or any other architect, in the rare instance when such buildings even involved the efforts of an architect.

The purpose of presenting a selection of stations at the beginning of this study, even before the theoretical setting in which their significance as institutions can be fully understood, is to create an archive of images. Such an archive stands as a corrective to what must be regarded historically as one of the defining traits of the stations: their invisibility. By this is meant their striking absence from historical literature of science, landscape, or architecture.[84] It is their marginality with respect to institutions such as museums of natural history and their generally unremarkable status as works of architecture which assured that they would be overlooked. Their autonomous emergence out of research

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82 Quoted in Yvette Conry, *L'Introduction du Darwinisme en France au XIXe Siècle* (Paris: Vrin, 1974) p. 238.

83 Loyer, "France," p. 104.

84 One notable exception is Harry Paul, *From Knowledge to Power* (Cambridge: University of Cambridge Press, 1985), pp. 103–133, though discussion does little to remedy, is their presence as physical institutions. In invaluable source is Charles Atwood Kofoid, *The Biological Stations of Europe* (Washington: Government Printing Office, 1910).

practices makes them difficult objects to handle. In fact, they are best regarded as instruments for regarding the very places where they were built. Their invisibility results from that fact that they were background buildings: they gave order to their own surroundings.

An investigation into these buildings, then, immediately initiates an investigation of place and—as we shall see—its critical intersection with time and circumstance. In order to understand the significance of these constituent elements of experience in theoretical as well as concrete terms, this point of intersection will itself need to be situated in time and place. Lacaze-Duthiers's "Direction des Études" (1872), in which the motivation behind his plans to establish research was forcibly expressed, serves as a critical point of orientation:

> The role of the zoologist can not be reduced to counting the articulations of an insect, or the revolutions of a shell's spire, to create names, measure exterior characters, to passively contemplate without seeking to explain, to dominate the phenomena which living nature presents him! His mission is more elevated, the field of his studies is more vast.[85]

The acts of counting, measuring, and naming, which formerly served scientists with the means of putting nature in its proper place amid collections, were now brought to the national, geographic, and intellectual periphery, where they were used to lay out Lacaze-Duthiers's vast new field of study. This field included the conditions of his own livelihood. It is in the model of economy, or the arrangement of the scientific household (the *Oikos*), that the means of understanding a particular constellation of time, space, and circumstance will be examined. Such an approach reveals a manner of planning which is prior to the act of design. This conception of planning arranges the available means through which any given design could be realized. The stations must be understood as facilitating a means of

85 Lacaze-Duthiers, "Direction des Études," *AZEG* t. 1 (1872), p. 60.

research, ultimately of mediating experience. Thus they will not be regarded as products of design, but as plans of action: they gave structure to ways of seeing, knowing, and acting upon an entirely new world: the sea. In so doing, they influenced the way we might perceive the physical and intellectual landscapes of which they are a part.

Chapter II

NATURE'S ECONOMY

> Sitôt que commencent les pluies de l'équinoxe d'automne, dès que le froid se fait sentir, ces populations nomades se dispersent. Les barilleurs s'éloignent les premiers; bientôt le nombre des carriers diminue; enfin les Blainvilais regagnent leur petit havre sabloneux, et pendant tout l'hiver il ne reste dans ces îles que les employés de la ferme et deux ou trois familles de tailleurs de pierre—Armand de Quatrefages, *Souvenirs d'un Naturaliste* (1854)[1]

In this chapter, a seeming patchwork of research problems will be shown to represent the diverse scales and settings in which Milne-Edwards and Audouin pursued their study of nature's economy. Conversely, and just as importantly, we shall see how this economy intervened in the situation of the house they occupied along shore and from which they followed these diverse orders of events and arrangement of things. Their house on the

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1 Armand de Quatrefages, *Souvenirs d'un Naturaliste* (Paris: Charpentier, 1854), I, p. 39.

Chausey Island was the prototypical research station. In studying the various seasonal industries which the small island attracted, their understanding of place was based as much on the "initial state of things" as the "meteorological circumstances" as well as "local particularities" which caused them to be redistributed in recognizable patterns.[2] Notably, the very terms "station" and "habitation" described coordinate factors in biogeography, or the study of the regions and physical conditions in which particular living beings can be found. A similar logic, it will be argued, held for where research outposts were to be properly established.

Their own situation on the island itself reflected one order of movement, motivated by the opportunity to study living nature. Before research stations could become fixed structures, Milne-Edwards and Audouin first needed to determine how things were distributed in nature and by man. The extensive statistical tableau which comprises a large part of their *Recherches* reflects their efforts to take account of the various regional industries, to which their own labor as naturalists was in some sense being added. Indeed, one observer noted that it was "despite all this movement" that the naturalist directed their attention to their own work.[3] But intrinsic to that work was the arrangement of the conditions under which observation could take place.

Theirs was a science based on principles of domestic economy, mirroring, in parts, what they perceived to be the economy of nature itself. Originally, economy (*Oikonomia*) referred to the management of the household, the *Oikos*. Indeed, this sense of the word was

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2 Milne-Edwards, "Quelques Remarques sur l'Emploi du Sel en Agriculture," *Société Nationale et Centrale d'Agriculture* (1849), p. 13.

3 Vicomte De Gibon, *Un Archipel Normand, les Iles Chausey* (Coutances: Imprimerie Notre Dame, 1918), p. 539.

intrinsic to the articulation later in the century of the concept of ecology.[4] Economy's meaning in classical discourse is made evident in Vitruvius's discussion of the economy of architecture, which referred to the proper management of materials and of site, as well as the thrifty balance of cost and common sense in construction works.[5] At the start of a long traditions of architectural discourse, including the writings of Alberti, the household as a locus of the natural ordering and prudent arranging is central to Xenophon's treatise on household management, *Oeconomicus* So that nothing is lost or wasted, everything is put in the place which naturally belongs to it.[6] The naturalists' first voyages to the coast reveal a complex sensibility to the management of materials of site, and to the elements which constituted their seat of observation. If they were not yet ready to undertake works of construction, the plan for eventual research establishments can be found in the literal practice of housekeeping which allowed them to remain at the coast.

THE HOUSEHOLD ECONOMY

During their first visit to Normandy, Milne-Edwards and Audouin stayed in the homes of fishermen, exploring the "vast shore" and determining the best places to collect specimens. Toward the end of the first voyage, they made an excursion to the Grand Ile of

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[4] See Donald Worster, *Nature's Economy, A History of Ecological Ideas* (Cambridge: Cambridge University Press, 1977), p. 37; Bernard Balan, "Premières Recherches sur l'Origine et la Formation du Concept d'Économie Animale," *Revue d'Histoire des Sciences* t. XXVIII, n. 4 (October 1975), pp. 289–326. On concept of ecology, coined in 1886 by Ernst Haeckel as the "housekeeping of nature" [*Haushalt der Natur*], see Robert Stauffer, "Haeckel, Darwin, and Ecology," *The Quarterly Review of Biology* 32 (1957), pp. 138–44.

[5] See Werner Szambien, *Symétrie, Goût, Caractère* (Paris: Picard, 1986), p. 159–160; Claude Perrault, *Les Dix Livres d'Architecture de Vitruve* (Paris: Pierre Mardaga,1988 [1684]), p. 14, n. 19.

the Chausey Islands. The richness of its fauna immediately designated it as the destination for their subsequent excursions.[7] However, if the region abounded in ascidia, in which "the pulsation of life" seems to have started, it was certainly not inviting. Nonetheless, studying the ascidia in their living state would allow them to understand how an organism which, in an adult state, is "attached in an immobile manner to some sort of foreign object," was yet able to propagate its offspring "afar." As will become evident, the spatial dimension of animals' habitations were part of their consideration. In terms of the setting of their researchers, the landscape bore the imprint of some catastrophe of nature, they wrote, the constantly agitated sea crashing against the rocky shore. Depending on the level of the tides, land bridges formed between certain of the islands and other disappeared altogether. Their geological observations were mixed with but a few picturesque elements, such as the ruined chateau at the base of the island's port. But they did not come as tourists, as least not of the scenic variety. Rather they were there to carry out a new amalgam of observation and experiment in which the particularities of place figured centrally.

The first problem to confront the naturalists, however, was not anatomical, physiological, nor zoological in nature, but rather domestic. There were no inns on the islands, so the naturalists were grateful to receive permission from the proprietor to establish themselves in one of the islands' sole permanent habitations, a large farm house.[8] They described it as a miserable thatch-covered cottage, which had little more to offer than its four walls. The naturalists were provided with only the rudiments of a building, a

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[6] For a compelling discussion of the notion of economy in the development of the spatial classification of the household, see Mark Wigley, "Untitled: The Housing of Gender," in Beatriz Colomina, ed., *Sexuality and Space* (Princeton: Princeton Architectural Press, 1992), pp. 327–389.

[7] Milne-Edwards, Audouin, *Recherches*, I, p. 82.

[8] Ibid., I, p. 51.

hearth, walls, and roof, but little in terms of comfort. They brought with them mattresses, linen, and chairs, and after six hours arranging their domicile, they were ready for work. It served, despite its limitations, as their seat of observation.[9] Quatrefages found little altered about the ensemble when he came to the farmhouse thirteen years later in 1841. The interior walls were blackened from the dampness, in places where the questionable remains of a long since applied coat of paint were still visible. Like his predecessors, he made-do with a few pieces of furniture on the sloping floor of the room; a large table fixed to the wall became his laboratory.[10]

Audouin expressed pleasure that in one of the rooms, at least, there was a window and a fireplace so that cooking and microscopic and anatomical observations could take place side by side.[11] In these tasks the naturalists were ably assisted by their wives. Their hands, Audouin wrote, went from the broom handle, to the drawing pen, to the frying pan with great facility.[12] Everyone in the house was variously and continuously occupied, the women joining the men during their rounds of collecting and helping them to record the specimens as the naturalists discussed the significance of what they had found.[13] In addition to aiding the work of research, the wives contributed to the ordering of the household. They belonged to the household economy, carrying out essential task of management; they were part of the house's ordering of nature, even if the house itself was a makeshift structure. With the development of permanent research stations, their role would

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9 Audouin letter to professors of the Muséum (Paris: November 24, 1828), quoted in Jean Théodorides, *Un Zoologiste de l'Époque Romantique, Jean-Victor Audouin (1794–1841)*, p. 59.

10 Quatrefages, *Souvenirs*, I, p. 13.

11 Ibid., p. 59.

12 Ibid., p. 59.

be replaced by the full-time service personnel whose labor was the precondition of that of the visiting naturalists.

With its walls almost lapped by the sea, the farm was ideally situated for the naturalists to begin their research.[14] The first and only construction they undertook in preparation was to dig a number of basins into the ground which were fed with supply lines connected directly to the sea. This "open air" observatory allowed them to keep specimens for an extended period until they were ready for them.[15] Now able to determine the pace of their work, they were able to augment and even correct observations made by traveling naturalists who, having literally run out of time to work on the spot, worked from specimens conserved in liquids.[16] The basin was a constantly renewable source of research. Numerous other small glass receptacle not only kept their specimens alive but served as an optic through which to view their vital functioning. In resolving the question of how ascidia, which as adults are fixed to rocks disseminate to form new colonies, they observed them in their mobile larval stage, when they searched the perimeter of the glass for a "suitable point to establish their habitation."[17] These experimental subjects were not merely inhabitants of the experimental container but were "captive" to it. For their part, the naturalists' own initial labor was spent determining suitable points of research and establishing viable habitations, aided by their wives' economical hand. If they were captive in some sense, it was to the hospitality which they were obliged to accept in order to stay by the shore.

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13 Henri Milne-Edwards, "Notice sur la vie et les travaux de Victor-Audouin," p. 382.

14 *Recherches*, I,p. 69–70.

15 Milne-Edwards, Audouin, *Recherches*, I, p. 70.

16 Ibid., I, p. 132–133.

17 Ibid., I, p. 72

Chapter II

Whereas our knowledge of the material circumstances of Milne-Edwards's and Audouin's voyage to the Chausey Islands stems from a few letters and scattered impressions gleaned from their scientific papers, Milne-Edwards's voyage to Sicily in 1844 in the company of entomologist Émile Blanchard and Quatrefages was evoked with considerable literary skill in Quatrefages's *Souvenirs d'un Naturaliste* (1854). With each of its chapters headed by a placename, this self-described work of scientific popularization was originally serialized in the *Revue des Deux Mondes*, the pages of which were increasingly being devoted to scenes from the shore.[18] Though packed with alluring descriptions of these place, the book conveys the daily efforts the naturalists made to assure themselves of the "necessities of life." The most pressing necessity, of course, was shelter. The naturalists spent the first few nights of their "little circumnavigation" of the island "in bivouac," sleeping under a tent they set up aboard their rented vessel. His discussion of the houses they subsequently called their stations contain some important insights into forms of hospitality. Quatrefages's description of these stations fills out our understanding of how the scientific household was secured, especially in a foreign land. These passages from the *Souvenirs*, which in terms of genre could not be more different from the *Recherches* in which Milne-Edwards and Audouin recorded their essentially statistical impressions of the Chausey Islands, warrant a brief excursus.

Far from adopting the official tone Milne-Edwards used for his official report of the voyage, in which he explained to the minister that it was a necessary complement to his work with Audouin on the Chausey Islands, Quatrefages's narrative of how the naturalists

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18 Alain Corbin, *The Lure of the Sea*, trans. Jocelyn Phelps (Berkeley: University of California Press, 1994), p. 118.

went about meeting the necessities of life sometimes bordered on farce.[19] After presenting letters of introduction (they might as well have been letters of credit) they bore from local notables to the commandant of a French garrison, the commandant put his own country house at their disposal. Upon their arrival, they found a swarm of workers making three rooms ready for their stay. In the evening, the commandant's wife arrived on a donkey loaded with mattresses, kitchen utensils, and a dinner for the naturalists. As soon as they took possession of the house, which was very well situated with regard to the shore, they covered its tables with their instruments and study basins, improvising when the proper furniture for their researches was lacking. The commandant even had part of a stone garden wall knocked down to make it easier for the naturalists to transport their gear from the ship. But before they set out to work, they divided the household tasks among the crew of their ship. One of them became the cook and the other the housekeeper, neither of them performing to the naturalists' satisfaction.[20] The captain, however, remained aboard his ship, while the cabin boy was reduced to being the household "slave," carrying buckets of water up to the house to replenish the naturalists' basins. Quatrefages records the comical path of orders up and down this chain of commanding in what he claims was incomprehensible Sicilian dialect.

Though Milne-Edwards negotiated the salary of their crew without incident in Palermo, settling his eventual household costs proved more complicated. The naturalists learned that hospitality operated according to its own moral economy, especially in a land where ancient customs prevailed. After his visit to the Chausey Islands, Milne-Edwards

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19 Milne-Edwards, *Recherches Zoologiques Faites Pendant Un Voyage sur les Cotes de la Sicile, et sur divers points du Littoral de la France, Rapport adressé à M. le Ministre de l'Instruction Publique (Paris, November 10, 1844)*, p. 4.

20 Quatrefages, *Souvenirs*, I, p. 201.

signaled his gratitude to the proprietor of the farm by naming a species after him, Eunice *Harassei*.[21] It was quite literally a natural token of their gratitude. Similarly, they presented one of their Sicilian hosts with a certificate attesting to their appreciation; just as the their letters of introduction gave them social credit, opening doors to them, the certificate paid off their debts.[22] The Sicilians, as the naturalists soon found out, often expected other forms of consideration. Being unprepared for this rite, they offered their "compliments" in the form of some cash. When the social standing of one of their host made such a gesture inappropriate, Quatrefages took note of his clear vexation when the naturalists departed with only verbally tendered expressions of gratitude.[23] In one form or another, the naturalist paid rent for their accommodations. They further paid with the efforts they expended in making these temporary stations into proper settings for research. Naturalists would remain tenants for the better part of the next thirty years, until laboratories were established as their "own proper domain."[24]

Edmond Perrier wrote that in addition to their zoological studies, the naturalists' voyages to areas until then visited only by quarrymen, fishermen, and soda burners led them to broach a series of "economic questions."[25] Indeed, Milne-Edwards and Audouin wrote that the very "circumstances" of their voyages presented the opportunity to conduct

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21 Vicomte De Gibon, *Un Archipel Normand, les Iles Chausey*, p. 540.

22 Quatrefages, *Souvenirs*, I, p. 214.

23 Ibid., I, p. 273.

24 Carl Vogt, "Les laboratoires de zoologie maritime," *Revue Scientifique* 2 ser., 5 année, no. 49 (June 3, 1876), p. 542.

25 Edmond Perrier, "Henri et Alphonse Milne-Edwards," *Nouvelles Architeces du Muséum d'Histore Naturelle* ser. 4, t. 2 (1900), p. XL.

extensive statistical analysis of the regions they visited.[26] Statistics was understood as the study at a given moment of a territory, its population, production, and consumption, and was used by the state to manage its "household."[27] As Marie-Noëlle Bourguet has written, territory was for the statistician what the space of the herbarium, cabinet, and botanical garden were for naturalist.[28] Indeed, it was precisely in rejecting the model of the cabinet, that Milne-Edwards and Audouin accepted the task of understanding the ordered relations of their new field of research. Even if they rejected the idea of producing an inventory of nature, it would be wrong to argue that the proper object of their research was territory. Rather, their work evinces a compelling series of examples in which the inventory of nature was overlaid on a territory of their own definition. Their own need to study by the coast was an expression of how their own knowledge was situated. The point to be emphasized, however, was that the situation changed according to the time of day or season of year.

Just as their voyage to the coast reprised elements of Cuvier's early career, Milne-Edwards's and Audouin's statistical work took up a thread in the history of observing the coast. As Alain Corbin has discussed, in the eighteenth century an awareness of the insalubrious effects of diverse coastal industries led the Académie des Sciences to send out inspectors to make a comprehensive survey of the littoral.[29] Among the most offensive

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26 Milne-Edwards, Audouin, *Recherches*, p. iv.

27 Theodore Porter, *The Rise of Statistical Thinking 1820–1900* (Princeton: Princeton University Press, 1986), p. 153. See also, Jean-Claude Perrot, "The Golden Age of Regional Statistics (Year IV–1804)," in Jean-Claude Perrault, Stuart Woolf, eds., *State and Statistics in France 1789–1815* (New York: Harwood Publishers, 1984), pp. 3–4.

28 Marie-Noëlle Bourguet, *Déchiffrer la France, la statistique départementale à l'époque napoléonienne* (Paris: Éditions des archives contemporaines, 1989), p. 83.

29 Corbin, *The Lure of the Sea*, p. 202–206. In particular Tillet and Parent-Duchâtel conducted extensive statistical examination of the littoral regions, conducting interviews with people of all ranks. The activity escalated into a ongoing campaign of questionnaires

industries, in fact, was the burning of soda ash, a product in the glass making process, which took place on the Chausey Islands. The inspectors, noted naturalists among them, did not fail to use the opportunity to make detailed zoological observations at the low tide. But where the purpose of the earlier visitors was "to visit diverse points on the coast and made a report of their observations," in Milne-Edwards's words, his and Audouin's observation had pertinence to the places where they themselves worked temporarily side by side with ash burners, places which were among those potentially eligible as the site of a permanent research establishment. The naturalists did not merely progress through the littoral regions, but studied the patterns of distribution proper to the organism, the household, and the territory, essentially looking for a place to settle themselves.

Constructed of locally quarried stone, the farm where they lodged was considered the "capital" of the islands. It housed a number of stable and field hands, a domestic, a bread baker, and a bailiff responsible for overseeing the distribution of food and drink. Employing such a manager was essential on an island when communication with the mainland was still tenuous. The constant threat of scarcity meant carefully anticipating the needs of everyone on the island. The island's other inhabitants were the migrating fishermen, quarrymen, and especially the seaweed harvesters. Of course there was no manager to oversee how the island's diverse natural resources were divided among these migrant laborers. Rather regional custom, geography, ease of communication, and the market determined where concentrations of industry developed on the islands. Like the parasitic organisms which "sucked" from the blood stream of lobsters discovered by Milne-Edwards and Audouin, these villages were attached opportunistically to various points in

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and reports; see Madelein Pinault, "Diderot et Le Masson du Parc," in Jean Balcou, ed., *La Mer au Siècle des Encyclopédistes*, p. 345.

the archipelago.[30] The naturalists were themselves parasites in the information sense. Throughout their journeys they benefited from the "Friends of Science" (navy officers, fisheries inspectors, conductors of the Corps des Ponts et Chaussées, even members of local Linnaean societies) who had detailed knowledge of the place. This "dusting of islands" as Elisée de Reclus called them, was the site of any number of local conditions of order which the naturalists came to know.

One such assembly was the shanty-town Blainvillais, so-named after the seaweed harvesters who came in the spring from the port of Blainville. Another, the shanty-town of Malouins, was named for the quarrymen who came from that region to cut granite once the large-scale port projects in Granville and Saint-Malo began construction. Where the bailiff oversaw the farm's provisions, in Malouins there were two canteens where hard cider and tobacco were sold; Quatrefages had a word or two to say about the colorful mores which exhibited themselves as a result during the quarrymen's day off. The rest of the shanties were dormitories housing fifteen or so workers; in each resided a women charged with preparing soup for the community. Her quarters were separated from the rest by simple curtain, creating a rudimentary social division and preserving her modesty.[31] But while the naturalists were guests of the island's proprietor, the latter took advantage of the seasonal workers by charging them exorbitant rents in places such as Blanvillais. In defense of the practice, the proprietor wrote that the workers were "nullement obligé de venir y fixer ses

30 Milne-Edwards, Audouin, "Mémoire sur la Nicothoé, animal singulier qui suce le sang des Homards," *Annales des Sciences Naturelles* t. IX (1826).

31 Quatrefages, *Souvenirs d'Un Naturaliste*, p. 34–35.

demeure." As for the squalid shanties, they explained that "conditions of existence" could not be expected to be identical to those on the mainland.[32]

This dynamic would later be repeated in the exploitation of place in the name of sight seeing. On his first trip to Lannion on the Brittany coast in the 1850s, Lacaze-Duthiers found the "cyclopean" blocks piled up on its beaches to be the perfect shelter for marine animals. But with no hotels in the vicinity, he was left to manage on his own resources, living, as he himself tellingly remarked, "truly as Crusoe." Of course, Crusoe was the very model of the archly practical man who was deprived of the "strange multitude of little things" necessary for daily life. As Anthony Vidler notes, like the tourist or colonial administrator, he is forced to make do, "to improvise in his new surroundings a fair imitation of the home he had temporarily left."[33] The situation greatly changed when Lacaze-Duthiers returned twenty years later. The local inhabitants, realizing the "picturesque" allure of their own stretch of the coast, created "des habitations habitables, pour chercher à se faire des revenues avec les étrangers, considérés, dans quelque autre points du littoral, comme étant la première et la meillure des récoltes."[34] Regions which initially were (relatively) uninhabited became prohibitively expensive to working naturalist once they were sought after by vacationers.

The question of where it was natural for different industries to establish themselves is further discussed in the study Milne-Edwards carried out of the fisheries. The "Considerations sur l'état actuel des Pêches maritimes en France," he wrote, were of as

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32 Vicomte De Gibon, *Un Archipel Normand, les Iles Chausey*, p. 528.

33 Anthony Vidler, *The Writing of the Walls* (Princeton: Princeton Architectural Press, 1987), p. 13; the phrase "strange multitude of little things" come from Defoe.

34 Lacaze-Duthiers, "Sur les laboratoires de Roscoff, Banyuls et les Archives, *AZEG*, ser. 3, t. VI (1898), p. 4.

much interest to the zoologist as the statistician.[35] Using proportions established in a treatise on the population of France, Milne-Edwards established the overall number of fishermen. Yet it was not their absolute number which interested him, but their distribution. To examine the latter, he proposed a "natural" classification of the fishing industry, like the natural order he would introduce into the collections at the museum, according to the various fish stocks the fishermen went after. He explained,

> les unes ont pour object les poissons qui séjournent habituellement dans les mêmes parages et que l'on appeler *poissons sédentaires;* d'autres sont dirigées d'une manière spéciale contre les poissons voyageurs qui ne s'approchent de nos côtes qu'à une certaine époque de l'année, et s'en éloignent quelque temps après; enfin la troisième classe comprend la pêche, ou plutôt la récolte des animaux marins qui vivent stationnaires au fond de la mer, et qui sont pour ainsi dire des produits inhérens au sol."[36]

Where Duhamel de Monceau had divided the industry in terms of the instruments it used—hooks, nets, and "other means"—Milne-Edwards sought to explain the size and location of fishing communities, including their relative economic status, according to the modes of habitation (*séjournent, voyageurs, stationnaires*) of their catch. (The indigent women and children who traditionally harvested the "inherent products" of the strand did not figure into his analysis.) In his dual role as statistician and zoologist, Milne-Edwards allowed him

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35 Milne-Edwards, Audouin, *Recherches*, I, p. 241.

36 Ibid., p. 262. Traditionally the industry was arranged into three classes: the *grande* and *petite pêche en mer*, and *la pêche du rivage*. The first, principally for cod, takes place "dans des parages lointains," in well-equipped ships. The second class, far less remunerative, was carried out in small boats nearer to the shore. The third, the one which most resembled their own work, *la pêche du rivage*, was carried out on foot during the low tide and employed a large number of the indigent women.

to correlate the location and size of fishing villages according to the distribution of different stocks of fish.

Audouin's accompanying statistical analysis, "Recherches sur les naufrages qui ont lieu sur les côtes de France . . ." equated accidents of terrain, irregular topography and changeable circumstances, with the rate and distribution of accidents (fig. 2.1). His discussion of the number of the distribution of shipwrecks was based not on rates of traffic, but "the situation of each locality."[37] Incidentally, the naturalists' visit to the Chausey Islands coincided with Beautemps-Beaupré's hydrographic survey of the region. Beautemps-Beaupré guided them through reefs and through waters which had never been explored by naturalists at the very time they were being fixed on maritime atlases.[38] It is possible, in fact, to place Audouin's analysis of shipwrecks within a range of practices which not only made navigation safer, but identified the distribution of risk itself as a function of time, place, and circumstance. To be sure, shipwreck statistics played an important role in the emergence of modern maritime insurance. As Lorraine Daston has explained, the wide range of information sources which allowed insurers to apportion risk and gain—the season of year, the route taken, the condition of a ship, the skill of its crew, recent good or bad news, etc.—was overlaid on a customary understanding of what circumstances it was possible to foresee.[39] If these means were to "domesticate risk," they did so by substituting for the virtues of prudence a parsimony which, in the domestic context, preserved a family's fortune. Curiously, the reason given by the proprietors of the

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37 Ibid., p. 379.

38 Milne-Edwards, Audouin, *Recherches*, I, p. 86.

39 Lorraine Daston, "The Domestication of Risk," in Lorenz Krüger, Gerd Gigerenzer, Mary Morgan, eds., *The Probabilistic Revolution* (Cambridge: MIT Press, 1990), I, p. 254.

Chausey Islands for the high rents they charged was the enormous risks that they assumed in catering to seasonal and migrant workers.

Milne-Edwards and Audouin both used tables to express the results of their statistical campaigns, explaining that such graphic means was the most effect way to bring out the relationships which exist between different series of facts, or between different facts within the same series of facts.[40] To be sure, the *Recherches* was filled with the thick descriptive passages characteristic of regional statistics, ranging from the "picturesque scene" of the flames rising along shore from the soda burners' furnaces to the drinking habits of the quarrymen. But the tables themselves were not descriptive catalogues of things, but registers of events transacted at particular places in space and time. Placenames attach to the gridded field almost as ornamental features, designating where these scenes took place. The graphs compressed into the width of single fluctuating line the masterful painterly perspectives of a Vernet in his "Ports of France." Each view, the vantage point of which Vernet carefully considered, comprised a synthetic and synchronic view of a world in transit.[41] The result was a minute description of a generous miscellany of things. It was a tableau in the sense of a tabulation.[42] The naturalists' seat observation was a counting house of sorts, monitoring a region over the surface of which were distributed a heterogeneous economy.[43] The line was to become the visible trace of physiological events which took place within the animal economy.

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40 Milne-Edwards,Audouin, *Recherches*, I, p. 360.

41 For a recent discussion of the economic imagery of the port and maritime space see Allan Sekula, *Fish Story* (Düsseldorf: Richter Verlag, 1996).

42 Michel Serres, Hermes, "Turner Translates Carnot," in *Literature, Science, Philosophy* (Baltimore: Johns Hopkins Press, 1982), p. 55.

43 On graphs see Thomas Hankins, Robert Silverman, *Instruments and the Imagination*

Chapter II

CIRCULATION

As Jean-Claude Perrot has suggested, "statistical topography contained an implicit economic mode, the statistician was the Vaucanson of his society."[44] Vaucanson had minutely decomposed and recomposed the movement of life in producing his life-like automata. Milne-Edwards's and Audouin's discussion of circulation, a process constitutive of economic exchange, suggested comparisons between the animal economy and human industry. Their studies revealed how the aggregation or association of functions, rather than the elaboration of distinct forms, was the key to understanding the organism. By their own account, these studies involved the most "circumstantial" of their observations. The naturalists needed to be supplied daily with a large number of specimens of a suitable size, subjected to experiment as soon as possible after they were taken from the water.[45] Indeed, there was a premium to be paid to the local fishermen for their cooperation. As Milne-Edwards described it, the anatomical (descriptive) manner of understanding living beings needed to be allied to this physiological (functional) approach. In a similar vein, Claude Bernard wrote that the famed surgeon Jean Mery said that the descriptive anatomist was like the porter one sees in a large city, who knows the names of all the streets and the numbers on all the houses but has no idea of what takes places inside them. [46] Milne-

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(Princeton: Princeton University Press, 1995), pp. 120–128; It was no coincidence that one of Milne-Edwards's students, Etienne-Jules Marey, developed the automatic inscription device which gave rise, in physiology, to the graphical method, an important precursor to cinematography, see François Dagognet, *Etienne-Jules Marey, A Passion for the Trace* (New York: Zone Books, 1992).

44 Jean-Claude Perrot, "The Golden Age of Regional Statistics (Year IV–1804)," p. 45.

45 Milne-Edwards, Audouin, *Recherches*, I, p. 47.

46 Claude Bernard, *Leçons sur les Phénomènes de la vie, communs aux animaux et aux végétaux* (Paris: Librairie J. B. Baillière et fils, 1879), p. 7.

Edwards's and Audouin's experiments on living organisms took them beyond the description of structure and form and led to a new understanding of how vital functions were "localized" in the animal economy.[47]

The localization of function corresponded with the specificity of form in the machine-like exo-skeletons of crustacea.[48] Crustaceans, Milne-Edwards argued, are constructed of twenty-one segments, the so-called zoonites. Notably, his discussion of these metamorphic structures involves a duality between Cuverian functionalism and transcendental morphology that resolved itself in an understanding of the means of vital production which had neither form nor function as its premise. Milne-Edwards regarded the enormous variety of bodily configurations as a vivid example of nature's law of economy, whereby a single series of analogous materials result in a great number of diverse "instruments."[49] An individual zoonite could be either independent or fused to another, forming a functional assemblage. Thus did the animal's bodily configuration respond to its mode of existence: mobile, fixed, or parasitic. Each zoonite was an apparatus which was more or less intimately tied to the organic function (locomotion, prehension, vision, tact, respiration, and generation) housed within it.[50] The appearance of the zoonites was itself a function of external circumstances. Chemical assay revealed the influence which difference conditions of light and temperature had on the outer tegument.[51] The form and

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47 Henri Milne-Edwards, *Histoire Naturelle des Crustacés* (Paris: Librairie Encyclopédique de Roret, 1834), I, p. 58.

48 Milne-Edwards, *Histoire Naturelle des Crustacés*, I, p. 13.

49 Milne-Edwards, "Notice sur la vie et les travaux de Victor-Audouin," p. 374; see Toby Appel, *The Cuvier-Geoffroy Debate* (New York: Oxford University Press, 1987), pp. 109–112..

50 Milne-Edwards, *Histoire Naturelle des Crustacés*, I, p. 4.

51 Ibid., I, p. 10 n. 1.

arrangement of the zoonites ultimately described the localization of the vital function. Milne-Edwards literally cracked open this outer shell in order to examine the phenomena of life, which was sheltered and facilitated by the outer housing of the zoonites.

It was particularly in the context of his and Audouin's studies of circulation that Milne-Edwards elaborated his concept of the physiological division of labor.[52] Milne-Edwards wrote that the principle followed by nature in the perfection of beings was the same as that followed by modern economists, and that the advantages which result from the division of labor can be seen as much in works of nature as in the production of industry.[53] Significantly, it was during this period that Milne-Edwards taught the course in "l'histoire naturelle industrielle" at the École Centrale des Arts et Manufactures, known as the "Sorbonne industrielle."[54] But the animal to machine analogy suggested by Milne-Edwards is greatly complicated by the fact that the concept of the division of labor was used by him to explain how vital function (*le travail*) was accomplished where the proper anatomical structure for it was lacking. In a word, his study of circulation identified the "formless" (*informe*) components of the animal economy. The formless referred to rudimentary or undesignated passages which existed in between definable organs. In most

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52 See Milne-Edwards, "Les Nerfs" and "Organisation," in the *Dictionnaire classique d'histoire naturelle* (1827).

53 Henri Milne-Edwards, *Histoire naturelle des Crustacés*, I, p. 5–6.

54 A directive of November 13, 1833 from the school's director, Olivier to Milne-Edwards suggests the actual extent the crossover between physiological and mechanical conceptions of labor: "votre cours est encore trop théorique, il faut le rendre plus industriel; l'année dernière, les élèves ont fait ces remarques . . . Tacher donc de donner une couleur industrielle à votre cours," quoted in Francis Pothier, *Histoire de l'École Centrale des Arts et Manufacture* (Paris: Delamotte Fils et Cie, 1887), p. 127. The school was meant to meet the urgent need for "médecins des usines et des fabriques," Charles De Comberousse, *Histoire de l'École Centrale des Arts et Manufactures* (Paris: Gauthier-Villars, 1879), p. 13; see also Terry Shinn, "From 'Corps' to 'Profession': the Emergence and Definition of Industrial Engineering in Modern France," in Robert Fox, George Weisz, eds., *The Organization of Science and Technology in France 1808–1914* (New York: Cambridge University Press, 1980), p. 191–94.

"degraded" organisms, in which vital fluids intermixed in a common vein, that strategies as opposed to structures of distribution were to be found. The significance of this distinction should not be underestimated.

For Milne-Edwards, the extent to which the division of labor had taken place distinguished whether organisms could be considered "aggregates," in which the notion of what constituted an individual was at stake, or as "associations," in which distinct complex processes were organized for the benefit of the whole.[55] Among the lower beings which had a uniform anatomical makeup, any individual part was sufficient to produce all vital phenomena. Employing what he identified as "the language of technology," Milne-Edwards explained that they were like "poorly directed workshops" in which each worker is responsible for every operation.[56] The only way to increase output was to increase the mass of living matter. In higher beings, in which the function rendered by each organ is differentiated, each organ acts mutually in the interest of the others. In this case output is increased through greater specialization of organic function, what Milne-Edwards called the "law of variety." But this did not necessarily entail the multiplication of organs as such. For the "law of economy" stated nature proceeds in the same way as human industry, creating a broad diversity of structures with the fewest number of innovations. A small number of basic animal plans served as the plan for myriad diverse species just as organs could lend themselves to diverse functions.

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[55] Henri Milne-Edwards, *Introduction a la Zoologie Générale*, I, p. 23. See Camille Limoges, "Milne-Edwards, Darwin, Durkheim and the division of labour: a case study in reciprocal conceptual exchanges between the social and the natural sciences," in I. B. Cohen (ed.), *The Natural Sciences and the Social Sciences* (Dordrecht: Kluwer Academic Publishers, 1994), p. 338, n. 18.

[56] Henri Milne-Edwards, *Histoire naturelle des Crustacés*, I, p. 5–6.

Milne-Edwards's and Audouin's circulation studies effectively called into question Cuvier's magisterial concept of the correlation of parts. Cuvier's ability to reconstruct an entire organism from a single fossil vestige had wide repercussions in literature as well as architectural theory.[57] But the very formalism of the precept that "form follows function" could hardly be applied to organisms which depended for their vital functions on formless cavities. Milne-Edwards wrote of Cuvier's teleology,

> Dans nos écoles, on admettait sans discussion que tout phénomène physiologique dépend de l'action d'un organe particulier et ne peut se produire que là où l'instrument existe et fonctionne; que, par conséquent, là où la fonction est remplie, l'agent spécial ne saurait être absent, et que la similitude dans les actes vitaux suppose la similitude dans la structure de la machine vivant."[58]

For Cuvier, Bernard Balan wrote, the integrity of the animal depended on the economic distribution of vital matter; organs were but so many centers (*foyers*) of exchange.[59] Milne-Edwards and Audouin were the first to explain how exchange might take place in the formless spaces between these organs.

Thus they placed on one end of a continuous scale organisms which had a circulatory system consisting of "lacunae," and on the other those in which well-defined

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57 David van Zanten, *Designing Paris, The Architecture of Duban, Labrouste, Duc, and Vaudoyer* (Cambridge: MIT Press, 1987), p. 225; on the biological analogy in architecture, see Peter Collins, *Changing Ideals in Modern Architecture* (Montreal: McGill-Queen's University Press, 1965), pp. 149–158.

58 Henri Milne-Edwards, *Rapport sur les progrès des sciences zoologiques en France* (Paris: Imprimerie Impérial, 1868), p. 186.

59 Bernard Balan, *l'Ordre et le Temps, l'anatomie conparée et l'histoire des vivants au XIXe siècle*, p. 73.

vessels formed "a complete circle."[60] Revisiting research that formed Cuvier's earliest papers on mollusks, Milne-Edwards and Audouin explained that the visceral cavity of the simple organisms served as a declassified "path of communication" accommodating afferent circulation and the distribution of nutrition.

Just as an "ideology of circulation" was central to the emergence of modern social and economic thought, the terms circulation and distribution had an important place in architectural discourse, both prior and subsequent to the use of circulation as a metaphor carrying specifically physiological meaning.[61] However, leaving aside metaphor and analogy, the purpose here has been to analyze how distribution gave rise to a particular understanding of time, place, and circumstance, and how its features could be understood.

The very identification of the occasionally formless nature of the circulatory apparatus stems from a particular method of approaching the study of life. Indeed, it might be asked how it was possible to examine these formless passages. Milne-Edwards and Audouin injected dyes into the heart of living specimens to follow its circulation. Where there were well-defined vessels, a clear path could be traced; lacunae became pools of dye. In either instance, the organism made itself visible by the very fact of its vital functioning. The distribution pattern of the dye, the directions and sequence of its flowing and pooling, was transcribed by the naturalists in their notebooks as so many vessels or formless, intra-organic spaces. Another technique involved simultaneously attaching a glass pipette to the specimen's heart, the beating of which was registered by the oscillating column of fluid.

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60 Milne-Edwards, *Rapport sur les progrès des sciences zoologiques en France* , p. 191. Cuvier, Duméril, "Rapport sur deux Mémoires de MM. Audouin et Milne-Edwards, contenant des Recherches anatomiques et physiologiques sur la circulation dans les Crustacés, fait à l'Académie des Sciences 19 mars 1827)," p. 397.

61 Rosalind Williams, "Cultural Origins and Environmental Implications of Large Technological Systems," *Science in Context* 6 (August 1993), pp. 75–101.

Their use of injections to monitor the organism served a purpose opposite of that to which the great anatomist Frédéric Ruysch put them. Using a compound which rapidly solidified, Ruysch made even the smallest vessels visible. Added to the profound interest of technique's ability to make the invisible visible, wrote Claire Salomon-Bayet, was the fascination of permanently fixing forms which were eminently corruptible.[62] Milne-Edwards's and Audouin's injections manifested vital processes even when its constituent structures were invisible; Ruysch's preparations protected anatomical structures from decay. In studying the organism, Milne-Edwards and Audouin introduced their means of visibility directly into the animal economy.

Among the signal observations resulting from Milne-Edwards and Audouin's visits to the shore concerned the variety and location of habitable places. Several years earlier, the Genevan botanist Augustin Pyramus de Candolle published his influential "Géographie Botanique" (1820), which gave the concept of stations and habitations wide currency.[63] And the terms, which originated with Linnaeus's discussion of the economy of nature, gained cogency when each province, town, or canton acquired a reliable flora listing its plants. Botanical and plant geographers often considered themselves census takers, even adopting the same statistical methods.[64] For Candolle, the enormous advance in the field then known as geographical history stemmed from the multitude of notes on physical

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62 Claire Salomon-Bayet, *l'Institution de la science et l'experience du vivant* (Paris: Flammarion, 1978), pp. 291.

63 Gareth Nelson, "From Candolle to Croizat: Comments on the History of Biogeography," *Journal of the History of Biology* vol, 11, no. 2 (Fall 1978), p. 270, 280–81.

64 See Janet Browne, *The Secular Ark: Studies in the History of Biogeography* (New Haven: Yale University Press, 1983), p. 78.

locations and geographical distribution of species made by travelers and naturalists.[65] Indeed, moving from neighborhood to neighborhood, as it were, Milne-Edwards's and Audouin's field notebooks precisely indicate the location and placement of each species they encountered.[66] The section "Distribution" in the *Recherches* examines the physical and spatial parameters of the life along shore.

In particular, the changing level of the tides, which for the naturalists was essential to carrying out observation, defined the distinct dwelling of groups of life forms along shore. Thus Milne-Edwards and Audouin identified four "stages" or "regions" between the limits of the high-low water mark, connected by the temporal element of the tide.[67] Defining these zones led Milne-Edwards and Audouin to consider the physiological relationships between an organism and the nature of the terrain.[68] Though the limited time they had along shore did not allow them to establish "precise rules" for these correlations, an important pattern was set in understanding the strand as defining distinct places of habitation and modes of life.

From their initial study of the local distribution of species defined by tidal regions, Milne-Edwards drafted an important study on the large-scale distribution of crustacea.[69]

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65 James Larson, *Interpreting Nature, The Science of Living Form from Linnaeus to Kant* (Baltimore: Johns Hopkins Press, 1994), p. 130.

66 Jean Théodoridès, "Les débuts de la biologie marine en France: Jean-Victor Audouin et Henri Milne-Edwards, 1826–1829," p. 429.

67 Milne-Edwards, Audouin, *Recherches*, I, p. 139.

68 Ibid., I, p. 123.

69 Philip Rehbock, *The Philosophical Naturalists, Themes in Early Nineteenth-Century British Biology* (Madison: University of Wisconsin Press, 1983), pp. 134–144. Rehbock separates the small-scale, local distribution of species, including vertical zonation, with large-scale, regional patterns. The first relied more on the immediate physical and biological circumstance (such as the tide), the latter with historical events and the play of isolation, by

Each marine species, like all terrestrial animals and plants, he explained, had its origin in a distinct center [*foyer*] of creation. Yet while some species remained "cantonnées dans leur patrie primitive," others were "disséminées au loin et ont été se mêler aux habitants des régions voisines."[70] In distinguishing between domestic and so-called cosmopolitan species, Milne-Edwards was forced to examine the role of physical and historical determinants. Specific topographic features such as long stretches of uninterrupted coast and strong sea currents, either facilitated or arresting the movement of animals which had relatively limited mobility. The extent to which a species was "local" or "cosmopolitan" was in direct proportion to its access to—or communication between—diverse regions.[71]

The second causal agent in Milne-Edwards's study of distribution was heat. Identifying it as one of the principle regulatory forces in nature, temperature seemingly explained facts of distribution which could not be explained by a species' capacity for self-locomotion nor by geographical features.[72] Milne-Edwards argued that as a general rule, the degree of perfection of a species showed a remarkable coincidence with the temperature of the sea.[73] It was for this reason that after his first visit to Normandy, Milne-Edwards traveled to the Mediterranean to make a comparative study of its more abundant and diverse fauna. In order to truly understand the variety of species, he explained, it was necessary to consider a multitude of potential influences which combine in an algebraic

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means of migration or other geographical means. The two processes, however, shared the terminology of stations and habitations, p. 119.

70 Milne-Edwards, "De la Distribution géographique des crustacés," *Histore Naturelle des Crustacés*, III, p. 556-57.

71 Ibid., p. 555.

72 Ibid., p. 591.

73 Ibid., p. 580.

fashion. Unfortunately, naturalists had no way of knowing how to isolate a single predominant factor in the modification of species in any given locality. In general, the study of distribution did not yet have the clarity or constancy that one found in the exact sciences.[74] What was clear, however, was that time, place, and circumstance were not generic categories into which a settled order of things could be accommodated. Rather they were dynamic factors in the ongoing arrangement of stations and habitations—of livable places.

In returning to the question of location and function of the experimental household, it is illuminating to look briefly at a study Milne-Edwards conducted during this period with the influential social hygienist Louis René Villermé, which revealed how the distribution of human habitation effected his "physiological economy."[75] The study examined the influence of temperature on the rate of mortality in newborns, focusing on the obligatory presentation of newborns to civil officer at the town hall, exposing them to risk during their transit.[76] In examining the mortality rates reported by the mayors of six communes from each department, Milne-Edwards and Villermé observed a range of expected variations between winter and summer, northern and southern climates. They then went on to compare the rate in urban areas, where houses were "agglomerated" around the city hall, and rural areas were they were "spread out" through the countryside. The extent of a newborn's exposure to the cold thus became a function of the density of housing which

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74 Ibid., p. 590.

75 René Villermé, Henri Milne-Edwards, "De l'influence de la température sur la mortalité des jeunes enfants," *Société Philomatique de Paris, Extraits des Procès-Verbaux des Séances* (1838) [first published in 1829], pp. 119–22; on Villermé, see William Coleman, *Death is a Social Disease, Public Health and Political Economy in Early Industrial France* (Madison: University of Wisconsin Press, 1982), 87–92.

76 M. Berthelot, "Notice Historique sur Henri Milne-Edwards," *Annales des Sciences*

determined the time of transit. The practical outcome of the study, was the recommendation that civic officials travel to the houses of families with newborns. In examining a practice, the presentation of newborns, which was itself central to producing social statistics, Milne-Edwards and Villermé established a relational pattern linking geography, the season of year, the density of habitation, and perturbations to the animal economy..

Analogously, in going forth from their own seat of observation, the naturalists at once established and were limited by the pattern in which specimens were either agglomerated or widely spread. The cycle of the tides, similar to the situation of the farm, all determined how their time would be spent and how productive their voyage would be. It was the ability to chose the place and circumstances of research, to have their leisure to study which allowed study of the animal economy to take place. But how did they judge their own rate of productivity, particularly with regard to their chosen place of research? The naturalists literally felt their way across the strand, overturning the stones which were the hiding places of delicate specimens, digging their hands into the silty bottom in search of bivalves. They ultimately judged the eligibility of the place with respect to the walks by which they carried out their collecting. Without losing time taking long walks it was easy to procure in but a few moments a prodigious number of specimens.[77] Theirs was a simple ratio of time and space. Indeed, it was research they carried out on the Chausey Islands, Quatrefages wrote, that gained Milne-Edwards entry into the Académie des Sciences.[78]

Doing so meant devising a mode of observation particular to time, place, and circumstance; the laboratory was an entity which emerged between the concept of the

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Naturelles, Zoologie XIII (1892), p. 17.

77 Milne-Edwards, Audouin, *Recherches*, I, p. 79.

78 Quatrefages, *Souvenirs*, I, p. 28.

station and habitation. To begin with, the naturalists' voyages to the Atlantic and Mediterranean coasts fostered two methods of collecting which were revealingly juxtaposed in Milne-Edwards's description of using a diving suit in Sicily, one of the first such descriptions of its kind. "Je voyais parfaitement tout ce dont j'étais entouré, et c'était la fatigue musculaire seulement qui m'empêchait de me promener au fond de la mer comme j'aurais pu le faire sur la plage."[79] The starling experience of being in the very thick of the vital, no less than the visual, milieu which, along the shore of the ocean, only the parting of the tides revealed was balanced by the palpable effort of negotiating so foreign an environment. The specific practices related to both types of observation will be discussed in later chapters; it suffices here to suggest how the economy, or distribution of things in nature and the situation of the naturalists were made finally to coincide.

The conditions in which Milne-Edwards made observations in Sicily, where the absence of tides forced him to use a diving suit to collect specimens, add another dimension to the equation of space and time. To begin with, the very "muscular fatigue" which resulted from working in the suit prevented him from "walking at the bottom of the sea like I would have done on the beach."[80] The tax of the marine environment through which he moved on his physiological economy limited his range of observation. During these underwater excursions, Milne-Edwards collected the embryos which served as the basis for an important study, which equated the importance of elements of the animal economy to their chronological appearance in the process of development.[81] Yet while Milne-Edwards

79 Milne-Edwards, "Recherches Zoologiques Faites Pendant Un Voyage sur les Cotes de la Sicile, Rapport adressé à M. le Ministre de l'Instruction Publique (Paris, 10 novembre 1844)," p. 6.

80 Ibid., p. 6.

81 Ibid., p. 9; Milne-Edwards, "Considérations sur quelques principes relatifs à la

stated the significance of his observations in terms of the embryological research of Karl von Baer, it was the time and place of their making that was a practical concern which necessarily proceeded conceptualization. Indeed, upon hearing of Anton Dohrn's plan to establish a research station, the aging Baer wrote of his disappointment thirty years earlier during a visit to Trieste to study sea-urchin embryos. "Naturalists came there from far away with little preparation, limited apparatus, and without any knowledge of the sites, even without knowledge about the appropriate seasons."[82] Baer arrived before the spawning season began and thus had no embryos to study; he was forced to return to Russia just as the season began, the academic authorities requiring naturalists to determine in advance the duration of their missions.

With this brief mention of Dohrn, whose research station at Naples was a source of mixed jealousy and emulation for its French counterparts, it is time to re-introduce Henri de Lacaze-Duthiers, who was responsible for translating his teacher Milne-Edwards's program of research into actual installations along the coast. Lacaze-Duthiers arrived in Paris in the early 1840s from "the depths of the provinces." Raised in a "distant chateau, closed off from movements outside by difficulties of communication," he came to the Sorbonne seeking to see and learn of nature what he had read in the works of Buffon.[83] In this regard,

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classification naturelles des animaux," *Annales des Sciences Naturelles* ser. 3 no. 1 (1844), pp. 65–99.

82 Von Baer to Dohrn (Dorpat 15/27 January 1873), in Christiane Groeboen, ed., "Karl Von Baer, Anton Dohrn, Correspondence," *Transactions of the American Philosophical Society* 83, part 3 (1993),p. 43.

83 Georges Pruvot, "Henri de Lacaze-Duthiers," *AZEG*, ser. 3, t. X (1902), p. 2; Lacaze-Duthiers, "Discours Prononcés aux Obsèques de M. H.-Milne Edwards" (Paris: Gauthier-Villars, n.d. [1886]), p. 16.

Lacaze-Duthiers was typical of the migration of talent to the capital.[84] In a report on the progress of science in the provinces, Milne-Edwards himself examined the distribution of intellectual talent. There was no reason to doubt, he wrote, the advantages of gathering the best and the brightest in well-endowed institutions. The constant interaction of the "pioneers" of advanced branches of science could only be to their mutual benefit. But these conditions were not always necessary for success. In the large cities where they are most often encountered, the effect is just as often counter-balanced by the myriad "inconveniences inherent to an agitated life." In particular, the immoderate excitation of the desire for celebrity caused professors to publish too much and too often.[85] To be sure, Milne-Edwards's scholarly output was prodigious. By the time this report was written in 1861, he could mention Lacaze-Duthiers, who was then teaching in Lille, as one of the bright lights of the provincial faculties. But beyond the dynamics of center and periphery which defined the topography of French academia, what Lacaze-Duthiers discovered in Milne-Edwards's amphitheater at the Sorbonne those twenty years earlier was the world which began at the edge of the sea.

Lacaze-Duthiers recalled that, as Milne-Edwards lectured on marine fauna, he rapidly draw on the chalkboard, indicating with but a few "salient traits" the essence of its organization. The concerted verbal and graphic components of the lessons were complemented by the presentation of conserved specimens arranged on a table at the front of the room. Milne-Edwards believed that oral (theoretical) instruction needed to be

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84 Mary Jo Nye, *Science in the Provinces, Scientific Communities and Provincial Leadership in France, 1880–1930* (Berkeley: University of California Press, 1986), pp. 1–2; Barnett Singer, "The Ascendancy of the Sorbonne: The Relations between Centre and Periphery in the Academic Order of the Third Republic," *Minerva*, vol. xx, no. 3–4 (Autumn-Winter 1982), pp. 269–300.

supplemented by practical (experimental) experience in order to correct the false ideas about nature that students obtained if they were limited to reading book or looking through "the glass doors of museum cabinets."[86] Thus after the lesson the students took part in demonstrations "on the things themselves," during which time the students had the opportunity to handle them directly. Milne-Edwards's course in zoology amply satisfied Lacaze-Duthiers's plan to see and to know the objects of nature. But the inspiration Lacaze-Duthiers received in Milne-Edwards's amphitheater extended beyond the once-living things under examination to the places where they lived. As he would later recall the group of students which gathered in a courtyard of the Sorbonne to discuss the day's class: "'La mer doit être bien belle à étudier avec son monde si varié et si curieux!' Aussi plus d'un alors brûlait secrètement du désir de faire des voyages d'observation."[87] Lacaze-Duthiers would be responsible for constructing two "annexes" of the Sorbonne at the shore.

In developing an understanding of the contributing factors to the economy of the place of research, it is instructive to note the distinct manner in which Lacaze-Duthiers recorded his own early voyages to the coast during the late 1850–60s.[88] Though lacking Quatrefages's literary sensibility, this narrative account manages to evoke the places he visited and offers an insight into the subjective experience of field work. At the end of each day, he dutifully recorded all he had "seen, done, and undergone." However, in the series of notebooks he kept during the years he was planning his stations, a deceptively casual

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85 Henri Milne-Edwards, "Discourse sur les Progrès des Sciences dans les Départements pendant la dernière Période Décennale," *Revue des Sociétés Savantes* 1 (1862), p. 54.

86 Henri Milne-Edwards, "Exposé Fait au Conseil Académique de Paris, sur l'Enseignement Supérieur des Sciences," *La Presse* (January 3, 1847), p. 4.

87 Lacaze-Duthiers, "Discours Prononcés aux Obsèques de M. H.-Milne Edwards," p. 16.

observation on "economizing" (that is, by carefully budgeting the nine-hundred Francs his mother gave him for his voyage to the Balearic Islands, he was able to continue his work in Normandy) become the substance of his account. As Geoges Petit has noted, large parts of the notebooks are little more than meticulous accounts of his daily expenses and movements.[89] If Milne-Edwards and Audouin marked the precise location and position of organisms along shore, Lacaze-Duthiers's day books indicate the hotels he stayed in, the room number, the price of his meals, sometimes even their quality. The notebooks present a precise account, not only how much was spent but where, when, and on what. The account is episodic and far from systematic, but it did subject seeing, doing, and undergoing to the act of managing resources and place.

Milne-Edwards and Audouin wrote that the diversity of local conditions on the Chausey Islands, its solitude, and the situation of the farm itself were advantageous circumstances for research.[90] But these favorable circumstances were but a temporary state of affair. They were house guests working in a hastily arranged laboratories. In a 1872 letter written from Roscoff, Lacaze-Duthiers made a plan for what was to come: "Je suis ici pour créer un laboratoire de zoologie, de cette zoologie que j'appelle experimentale par opposition à celle qui me semble trop de collection."[91] But in establishing such a place of research, he would have to do more than just replace the cabinet where collections were

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[88] The account has been lost, but portions of it were published in Georges Pruvot, "Henri de Lacaze-Duthiers, Sa Vie et son Oeuvre, "*AZEG* ser. 3 no. 10 (1902), pp. 1–78.

[89] These notebooks are now in the archives of the Laboratoire Arago; see Georges Petit highlights the aspect of accountanc , Henri de Lacaze-Duthiers (1821–1901) et ses 'Carnets Intimes," *Communications du Premier Congrès International d'Histoire de l'Océanographie, Monaco 1966*, pp. 453–465.

[90] Milne-Edwards, Audouin, *Recherches*, I,p. 69–70.

housed. The research station would have to establish its own economy, it would have to develop its own means of distributing time, place, and circumstance. Such a research station would minimize the bad timing, the lack of information which caused Baer, for instance, to miss his chance to conduct research at Trieste. But in leaving behind the silence of the cabinet, Lacaze-Duthiers had to come to terms with noise, to use an anachronistic term; he had to incorporate into his budget disturbances arising from the background of phenomena. In discussing his plans for his station, Lacaze-Duthiers says almost nothing about the kind of structure it was to be; rather, he describes the way in which circumstances sometimes prevent observation from taking place.

Coincidentally, the example Lacaze-Duthiers uses to illustrate his point is identical to the one Michel Serres employs to show how circumstance, all that is unforeseen, shapeless, random, "distributes" itself around any well-planned instance of seeing.[92] Serres's scenario involves the astronomer who relies on the regular, periodic order of the celestial system to calculate the exact moment of an eclipse. What he does not know, what he cannot predict, is whether he will actually be able to view the event. Lacaze-Duthiers's reference for this discussion was the hydrographer Ernest Mouchez. Earlier, Mouchez had given him passage on his ship bound for Algeria, so that Lacaze-Duthiers could retrieve the results of an experiment he set in motion twelve years earlier on the rate of growth of coral.[93] Mouchez was commissioned by the Académie to observe the Venus transit of 1874. As Lacaze-Duthiers explained, the mission required years of preparation, distant

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91 Lacaze-Duthiers letter to Alexandre Agassiz (Roscoff August 12, 1872), Harvard Museum of Comparative Zoology.

92 Michel Serres, *Hermes IV: Distribution* (Paris: Éditions de Minuit, 1977), p. 228.

93 Lacaze-Duthiers, "Leçon d'Ouverture du Cours a la Sorbonne 1873–1847" *AZEG* t. III (1874), p 23.

travel, and total isolation on a remote island which offered the best vantage. Yet Lacaze-Duthiers was palpably troubled by the risk that, at the very moment of the transit, Mouchez would encounter "clouds and an obscured and foggy horizon."[94] Despite all Mouchez's efforts to establish his station, the anticipated moment of observation and the event/object could remain unseen. As conceived by Lacaze-Duthiers, the research station, by virtue of its constitution as an economy, was the naturalist's means preventing such mishaps by of managing the resources of site (fig. 2.2). It was structured by the acts of foresight which were trained by an understanding of how circumstances and local particularities effected the distribution of things.

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94 Ibid., p. 24.

Chapter III

THE NOMADIC LIFE AND THE STATIONARY HABITATION

"Un point grave et capital, c'est le choix de l'habitation"

—Jules Michelet, *La Mer*[1]

Man, André Leroi-Gourhan writes, perceives the world around him in two distinct ways: a dynamic one whereby he moves through space to take cognizance of it, and a static one that enables him, while remaining immobile, to reconstitute circles around himself extending to the limits of the unknown.[2] This chapter examines how in its connection to the search for productive places of research, this tension between mobility and settlement structured the original notion of the research station. In analyzing the choices which were made between different vehicles of experience, including portable and/or temporary structures, it seeks to explain how the spatial and temporal ground of research was prepared for naturalists' occupation. The possibility of occupation, I argue, was coterminous with the type of planning that these structures made possible, rather than the resolution of this inner tension. In fact, the passage from a mobile to a settled state of

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1 All references in the text are to Jules Michelet, *La Mer* (Paris: Gallimanrd, 1983 [1861]), p. 294.

existence was an important structural feature of nineteenth-century architectural, historic, and scientific accounts of man's place in nature.

A long "tradition" of working at the sea's edge prepared the way for the "period of foundation of marine laboratories."[3] Or so claimed the naturalist Edmond Perrier, who founded the Muséum d'histoire naturelle's research station at Saint Vaast-le-Hougue in 1887. From its origin, however, the tradition involved the practice of improvising the elements of "temporary laboratories."[4] The choice of location for the Muséum's laboratory was validated by the fact that it was situated nearby the hotel where, sixty years earlier, Milne-Edwards stayed while researching the region.[5] The foundation of marine laboratories represented continuity and change in how naturalists experienced the shore. Perrier recognized as much when he identified two distinct periods in the development of the tradition: the nomadic and the sedentary. The "nomadic life" corresponded to the earliest voyages of observation; Quatrefages's *Souvenirs* was the exemplary narrative of the progress from station to station. These stations were not yet synonymous with built structures, but were areas circumscribed in place and time. Yet with Lacaze-Duthiers's establishment of his laboratory at Roscoff—a particularly choice location for research—the nomadic life gave way to the "stationary habitation" (*l'abri fixe*). Perrier himself transcribed the lease which transformed this "simple country house" into an "official laboratory of the Sorbonne." Thus came to an end the ongoing and costly process of moving from station to station.

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2 André Leroi-Gourhan, *Gesture and Speech* (Cambridge: MIT Press, 1993 [1964]), p. 326.

3 Edmond Perrier, "Préface," Armand de Quatrefages, *Les Émules de Darwin* (Paris: Félix Alcan, 1894), p. x.

4 Maurice Caullery, "La Station de Biologie Maritime de Tamaris," *Bulletin de la Société des Amis de l'Université de Lyon* VI (May 1898), p. 245.

Chapter III

It is not necessary to know whether Perrier was aware of the significance his periodization had in the anthropological discourse of his day to discuss it in terms of the origin and nature of human habitation itself.[6] The appointment of Quatrefages himself to the chair in the natural history of man at the Museum in 1854 represents far less of a disciplinary transgression than might at first appear. But anthropology here does not refer to what was then a newly emerging but nonetheless relatively narrowly defined scientific discipline. For our purposes, it implies a range of historic discourses which sought to define the *oikoumene*, the places of human habitation. The distribution and limits of these places were defined by the site(s) of human origin, mankind's subsequent migrations, and his capacity to adapt to new geographic and climactic settings. In focusing attention on the development of the marine station qua habitation, the factors which define how and where man lives can be posed along with the question of how his own understanding of nature is structured in thought as well as in material facts. This chapter will argue that the foundation of permanent stations was not simply the result of an earlier, nomadic period of the research tradition; rather, the type of research which took place at the shore had the habitation as its "premise."[7]

At the dawn of man, wrote Charles Garnier, the struggle for existence was not a metaphor: man's first actions involved "arranging a dwelling." The statement provides an initial insight into an architectural discourse which examined man's relationship to the

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5 A. E. Malard, "Le laboratoire maritime du Muséum de Paris," *Le Naturaliste* 2nd ser., no. 204 (September 1, 1895), p. 197.

6 There is reason to believe he would have been aware of this context. Perrier's final work, *La Terre Avant l'Histoire* (1920) was part of the series L'Évolution de l'Humaninté, which included Lucien Febvre's *La Terre et l'Histoire* and J. Deniker, *Les Races et l'Histoire*.

7 Massimo Cacciari, *Architecture and Nihilism: On the Philosophy of Modern Architecture*, trans. Stephen Sartarelli (New Haven: Yale University Press, 1993), p. 178

natural world. The fact that Garnier himself framed his discussion of the human habitation with reference to the anthropological literature of his day warrants historical scrutiny. But what his analysis shares with Jules Michelet's discussion of the habitation in *La Mer* and Lacaze-Duthiers's own reflections on the origin of his own research station which will be discussed here is the role of the nomadic and the fixed as structures of experience. As a number of scholars have observed, varieties of physical and spiritual homelessness were endemic to the realization of modern society.[8] Paris itself was considered a city of "nomads." Haussmann, whose demolition and reconstruction of Paris "alienated" it from its own residents, railed against the "rootless" work force which migrated to the city to realize his own projects but who had no place there.[9] The naturalists' project of finding a proper place for their research was itself a form of research, mediated by the arrangement of the experimental household. In one regard, the foundation of permanent stations recapitulates what nineteenth-century historians described as the natural evolution of the house itself. In another, they were the means of understanding the historic milieu in which that evolution took place.

THE HUMAN HABITATION

Conceived of as a gallery through which visitors could traverse all of time and space, Garnier's exhibit of "Human Habitation" at the Universal Exposition of 1889 restaged the natural evolution of the household. Consisting of forty representative habitations ranging

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[8] Anthony Vidler, *The Architectural Uncanny* (Cambridge: MIT Press, 1992), pp. 57–62; Francesco Dal Co, *Figures of Architecture and Thought, German Architecture Culture 1880–1920*, trans. Stephen Sartarelli (New York: Rizzoli, 1990), pp. 12–81; Kristin Ross, *The Emergence of Social Space: Rimbaud and the Paris Commune* (Minneapolis: University of Minnesota Press, 1988).

from cave dwellings to the salon of the modern bourgeois town house, the purpose of the exhibit was to allow the visitor to share the experience of its inhabitants amid their proper milieu, in the concrete reality of their life.[10] In terms which veritably echo Milne-Edwards's critique of the silent confines of the cabinet, Garnier wrote of the need to go beyond the "mute evidence" which was meticulously arranged in the museums of Paris. What was necessary for the study of the habitation was the equivalent of witnessing nature in its living state:

> Nous pouvions pénétrer vraiment dans leur intimité, surprendre sur le fait même les secrets de leur vie, nous asseoir à leur foyer, visiter leur habitations, examiner a loisir ce cadre matériel dans lequel leurs passions se sont agitées, leur intérêts se sont débattus, leur existence tout entière s'est déroulée?[11]

Though each of the habitations on display were (re) constructed from meticulous research based on a wide range of sources, the structures themselves were but vehicles for examining—re-animating —a mode of life. An accompanying book *l'Habitation Humaine* (1892) filled in the gaps between the architectural specimens with historic narrative. The "History" which distinguished the title of Viollet-le-Duc's *Histoire de l'Habitation Humaine* (1875) from Garnier's work marked a difference in approach to a similar set of domestic artifacts. Where Garnier's text was widely informed by scientific accounts of the past, Viollet-le-Duc invented a mytho-poetic origin for the house. Rather than set up a gallery, the narrators of his history are unstuck in place and time, and thus are witness to and intervene

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9 Christopher Prendergast, *Paris and the Nineteenth Century* (London: Blackwell, 1992), p. 14–15.

10 Auguste Ammann, *Guide Historique a Travers l'exposition des habitations humaines, reconstituées par Charles Garnier* (Paris: Hachette, 1889), p. 8.

11 Charles Garnier, Auguste Ammann, *L'Habitation Humaine* (Paris: Hachette, 1891), p. 3.

in the first acts of human industry and its subsequent issue. The work is a telling example of what has recently been described as Viollet-le-Duc's scientific imagination. The imagination connotes both a creative impulse and an archives of existing images already laden with significance.[12]

Garnier and Viollet-le-Duc describe in nearly identical terms the dust cloud produced by the migrant bands of Aryans, baked by the sun as they progressed from their primitive canton in the east to new and unknown lands in the west. They capture the "animated and picturesque" scene of nightfall, when their column of "mobile homes" came to a stop and camp fires were lit. Yet it was in drawing a line connecting the successive fire rings which were the markers of each of the nomads' encampment along their "sacred path" that Garnier produced the "Synoptic Table of the Historic Transformation of the Habitation" (fig. 3.1). The top of the table, which corresponds to the prehistoric period, is divided into natural shelters such as grottoes, and built habitations, including those on water and those on land. The table did not represent these primitive types of habitation, but rather arranged the races and nations of man. It was a schedule on the scale of history of the migrations of peoples over the surface of the earth and the habitable places they eventually occupied. The transformation of the habitation could only be understood in terms of the primitive "distribution of peoples" which the Aryan invasions forever changed. Throughout history, peoples and events progress from an unsettled to a settled state. In light of the emphasis Garnier and Viollet-le-Duc give to the fate of the races of man, the very names of the Celts and the Gauls, the nominal ancestors of Gaule, are shown to signify a mode of habitation. Garnier explained that "Celt" referred to the tents of a nomadic people. Only after they renounced their nomadic life did they assume the name "Galls," a

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12 See Laurent Baridon, *L'Imaginaire Scientifique de Viollet-le-Duc* (Paris: L'Harmattan,

word which signifies "cultivated lands" and fixed habitations.[13] This transformation was more than nominal; it implied a people's way of life and the particular geographic and historic circumstances in which it emerged.

The basis for studying the centers (literally *"foyer,"* a term that will be discussed in its broader signification in chapter four) of man's origin, his routes of migrations, and the places he finally inhabited was in many respects identical to Milne-Edwards's "distribution" of crustacea. According to Quatrefages, anthropology was essentially a special branch of zoology. Indeed, when he assumed the chair in the natural history of man at the Museum, he simply extracted from his "naturalist's baggage" a set of practices well-adapted to his new object of study.[14] Apart from these observational practices, what anthropology and zoology shared was the conceptual question of species. This fact explains the seemingly incongruent appearance of a polyp drawn by Lacaze-Duthiers as the first image in Quatrefages's *Histoire générale des races humaines* (1887). Preceding as it does images of human crania and aboriginal types, the drawing was not meant to represent man's biological origin. [15] Rather, the famous debate over whether polyps were animals or vegetables was meant to exemplify the problem of categorization which confronted the "naturalist anthropologist": did mankind consist of one race (monogenism) or several (polygenism). The underlying question was whether man was indigenous to all places on earth or had migrated from a single or even multiple centers of creation. Comparing

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13 Garnier, Ammann, *L'Habitation Humaine*, p. 404.

14 Edmond Perrier, "Préface," Armand de Quatrefages, *Les Émules de Darwin*, p. IX. Quatrefages wrote the section on anthropology for the compendious "Instructions Générales aux Voyageurs," issued by the Société de Géographie (1875).

15 George Pruvot, "Henri de Lacaze-Duthiers," p. 26.

mankind to the distribution of crustacea, was mankind which was now "cosmopolitan" originally localized?[16]

Developing an understanding of the human ecology, however, meant making certain critical distinctions between mankind and animals which have the ring of cliché. Yet man's capacity for industry and speech not only separated him from other animals, but was conceptually central to interpreting the ways in which he separated himself from his environment. The significance of the names Celt and Gaul is just one example. Employing Cuvier's method of reconstituting whole beings from isolated fossil remains, philologists of the period restored the society of the pre-historic races by tracing the common root of words such as "house" and "town" in Greek, Latin, and Sanskrit to their "germ" in central Asia.[17] In fact, one of the founding documents of the "system of race" in French nineteenth-century discourse was an award-winning essay on the survival of "Celtic" idioms in the French language written by the physiologist William Frederic Edwards.[18] In a preface, his brother Milne-Edwards described it as an important early step in writing the natural history of man, a project which combined the efforts of the naturalist, linguist, and historian.[19] Bearing this out, in a famous letter to Amédée Thierry, Edwards claimed that what the historian

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16 Armand de Quatrefages, *The Human Species* (London: D. Appleton & Co., 1879), p. 172.

17 Garnier, Ammann, *L'Habitation Humaine*, p, 289. Muller's "De la Philologie Comparée des Langues Indo-Européennes, par Rapport à leur Influence sur la Civilisation Primitive de l'Humanité" (1849).

18 Armand de Quatrefages, *Rapport sur les Progrès de l'Anthropologie* (Paris: Imprimerie Nationale, 1868), p. 31. Quatrefages credited Edwards's letter not only with the founding of the Paris Société Ethnologique (Milne-Edwards was one of its founding members), but also with the transformation of the chair of "anthropology and the natural history of man" at the Muséum d'histoire naturelle, p. 31. See also Elizabeth Williams, "Anthropological Institutions in Nineteenth-Century France," *Isis* 76 (1985), pp. 331–348).

19 William Frederic Edwards, *Recherches sur les Langues Celtiques* (Paris: Imprimerie Royales, 1844), p II.

deduced from "documents," he could establish by direct observation of living peoples.[20] The letter described the tour he took of France, Italy and parts of Switzerland—which incidentally coincided with Milne-Edwards's voyages to the Chausey Islands—where he abstracted racial types from the faces he studied in public squares.

Like Thierry, once Edwards established the "racial genius" of a people, he attributed to it a determining factor in the shaping of a nation's material and symbolic life.[21] The emergence of the nations of Europe from waves of Aryan migrations was another way of stating the pattern of settlement of diverse races. Seen in the longer *durée* of the origins of a race, Milne-Edwards understood the persistence of racial traits as tied to man's capacity to control his surroundings. He could do this by migrating to new regions, but also by sheltering himself from the unforeseen elements which he encountered there. Edwards explained the fact that the races of man did not undergo fundamental changes over time was only partially due to hereditary factors, what Quatrefages referred to as the "je ne sais quoi" in virtue of which traits are transmitted from parent to child.[22] The remaining part stemmed from his capacity to defend himself against the "inclemency" of the environment over the course of his far-reaching migrations. Inside his cabin and sitting beside his fire, even the Laplander could enjoy the heat of Syria. If the house could be cooled in the same way, he wrote, man could lead "a totally artificial life," changing his environment with impunity. Though Edwards does not take up the specific nature of man's habitations, he identifies the role of the *foyer*, the fireplace in preserving mankind. The national homelands

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20 W. F. Edwards, "Sur les caractères physiologiques des races humaines considérés dans leurs rapports avec l'histoire," *Mémoires de la Société Ethnologiques* t. I (1841), p. 1–2.

21 Claude Blanckaert, "On the origins of French Ethnology," in George W. Stocking, Jr., ed., *Bones, Bodies, Behavior* (Madison: University of Wisconsin Press, 1988), p. 18.

22 Quatrefages, *Rapport sur les Progrès de l'Anthropologie*, p. 133.

of Europe no less than their distinctive national homes evolved from the mixing of races through commerce, conquest, and communication.

The house, according to Garnier, materially "translated" before the eyes of the observer the intimate genius of a people.[23] Yet in tracing the route of man's historic migrations, Garnier and Viollet-le-Duc not only offer an image of how Europe especially was settled, but address the nature of habitation to which the nomadic and sedentary forms of life gave rise. Theirs was a more subjectively nuanced understanding of what, earlier in the century, Quatremère de Quincy characterized as the "three states of natural life," as if they were classical unities of time, place, and action: hunting and fishing, shepherding, and agriculture. To be sure, Quatremère complicated the notion of the primitive hut by positing the social and environmental conditions to which belonged a variety of types of primitive habitation: the cave, the tent, the hut.[24] But where Quatremère's types were conceptually immutable, the examples in Garnier's and Viollet-le-Duc's books were intrinsically historical. The force of the previous statement is not, however, to be found in the fact that the habitation is the product of some very particular set of circumstances. Rather, their analyses of the habitation is a means of experiencing those circumstances and managing them within the context of daily life. The evolution from the nomadic life to permanent habitation can be read in terms of a historical change in the scope of a people's spatial and temporal horizons.

The paradoxical origin of the habitation as a means of transportation is perhaps the most surprising element to confront the reader of Garnier's and Viollet-le-Duc's books (figs.

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23 Charles Garnier, *Augsute Ammann, l'Habitation Humaine* (Paris: Hachette, 1892), p. 4.

24 Sylvia Lavin, *Quatremère de Quincy and the Invention of a Modern Language of Architecture* (Cambridge: MIT Press, 1992), p. 21; see also See Joseph Rykwert, *On Adam's House in Paradise* (Cambridge: MIT Press, 1981 [2nd edit.]), pp. 33–42.

3.2–3). "Their boats served them as habitations," Viollet-le-Duc wrote commented on an illustration of a Viking ship stranded at low tide, over which were placed tarps serving for shelter, battens keeping the ship upright on its keel.[25] The ship is perhaps the most striking of the numerous images of tents, carriages, and other manner of moveable structures which appear throughout the text. Their habitations served as vehicles during the day and as shelters at night. As for the final distribution of the races, Arthur Gobineau wrote that the national home was nothing more than the wagon of the nomad which had come finally to a rest: "their wheels had been replaced by a solid stone based upon which rose a wooden edifice."[26] We will have the chance to examine mobile structures in their specifics in our discussion of portable research stations. Our present emphasis, however, will be on the structure of experience which the nomadic life entailed: what it meant to be Celtic, or a tent dweller.

As Garnier and Viollet-le-Duc described it, the caravan would set up camp along the route, preferably near a stream or a field where their livestock could graze. Once the fires were lit and the evening meal prepared, they faced the inevitable question: "should they take up the march again tomorrow?"[27] As they found their way through ever-new regions, the pace and trajectory of the nomads was determined by the terrain itself. They were constantly taking stock of their present situation which with each day's move was unfamiliar to them. If the country seemed equable, or if they needed a rest from their arduous march, they would set up temporary encampments. Their "furniture" was

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[25] Viollet-le-Duc, *Histoire de l'Habitation* (Paris: Hetzel, 1875), p, 295.

[26] Arthur de Gobineau, *Essai sur l'inégalité des races humaines* (1853), quoted in Laurent Baridon, *L'Imaginaire Scientifique de Viollet-le-Duc*, p. 113; see also Martin Bressani, "Notes on Viollet-le-Duc's philosophy of history: dialectics and technology," *JSAH* XLVIII (December 1989), pp. 327–350.

restricted to whatever could be carried with them during their "daily move."[28] Their encampments were pockets of space and time, each one marking their progress "from resting place to resting place." The horizon of "tomorrow" was always shrouded in unforeseen circumstances. The best the nomad could hope for was that he could find resting places where his needs could be met. The telos of Garnier's Synoptic Table was "modern times," modernity being linked in his narrative to a sense of control over the future course of events and security from one's immediate circumstances. However, it also posed the risk of subjecting man to a totally artificial life in which all differences between places were leveled through man's insistent acts of planning.

The centrality to both books of the Aryan migrations did not reflect their superiority as a race (though the notion of the inequality is an operative assumption of these texts), but rather the fact that it recapitulated the prehistoric emergence of the fixed mode of habitation. During their long habitation in central Asia, the Aryans went through the three stages of society. But over the course of their long migration, the Aryans had lost the tradition of construction which they developed on the plateau of Pamir. The migrants found themselves in ever new contexts to which they were forced either to adapt, using the skills they had brought with them, or acquire new industries through contact with or conquest of local populations. Naturally they were prone to imitate the habitations they found in these new lands which made best use of available materials and were adapted to the climate. But here Garnier signals a historical recursion, writing that the habitations of the primitive Gauls most likely resembled nothing other than the types constructed by prehistoric populations. Garnier divided prehistoric dwelling into natural shelter such as

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27 Garnier, Ammann, *L'Habitation Humaine*, p. 400.

28 Ibid., p. 35.

grottoes and dense tree cover, and constructed habitations on the land and the water. Surprisingly, perhaps, it was with houses built on water that nomadic tribes first gained purchase on place.

The 1854 discovery in Switzerland of the remains of lacustrine towns was an important episode in the nineteenth-century invention of prehistory (fig. 3.4). The piles on which these groupings of houses were built were revealed after an unusually severe cold spell that winter caused the water-level of lake Meilen to drop dramatically. The climatic anomaly exposed not only the foundation for the piles, but also a "relic bed" containing traces of domestic life; the prehistoric past percolated to the surface.[29] The range of subsequent excavations in the lakes of the region, some carried out with the aid of steam shovels used in railroad construction, led Quatrefages to refer to Switzerland as "the classic land of this antique industry."[30] Curiously, while Garnier extensively discussed the discoveries at Meilen, his reconstruction of the lake dwellings was based on observations of contemporary New Zealanders gathered by Dumont d'Urville during his voyage to the Pacific aboard the *Astrolabe* (1826–29).[31] In his book, Viollet-le-Duc included an image of pile houses of modern Burma. Both societies occupied the bottom tier of Garnier's Tableau: "Contemporary Primitive Civilizations." If the long-submerged lake bed offered one window onto the past, Dumont d'Urville's journey to remote regions effectively re-

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[29] For a discussion of percolation versus the flow of time see Michel Serres, Bruno Latour, *Conversations on Science, Culture, and Time*, trans. Roxanne Lapidus (Ann Arbor: University of Michigan Press, 1995), p. 58; Ferdinand Keller referred to this strata as the 'Cultur-schicht"; Frédéric Troyon, *Habitations Lacustres des Temps Anciens et Modernes* (Lausanne: Georges Bridel, 1860) refers to the formation of "véritables couches historiques," p. 5.

[30] Quatrefages, *Hommes Fossiles et Hommes Sauvages* (Paris: J. B. Baillière et Fils, 1884), p. 116.

established contact with civilizations left behind in time. Arguably, Garnier's understanding of the Aryan people was not in essence archeological, but based on the ethnography of contemporary Central Asia.[32] The genre of life of these peoples offered access to the historic evolution of their habitations.

The practice of studying what were then understood as modern-day primitives as evidence of the pre-historic past stemmed from the racist (as opposed to racialist) belief that these civilizations remained in an arrested state due to a lack of "communication" with the Aryan people. But it also betrayed a confidence in a uniform pattern of evolution subtending the wide variety of forms and shapes the homes of various nations and peoples ultimately assumed. The importance of the lacustrine towns was that they offered evidence—however it was variously interpreted—of a critical moment of transformation in this evolutionary pattern. The lacustrine towns represented the first type of habitation—prior even to houses on the dry land—which allowed them to cease their "perpetual displacement." At that point, the house became a means of managing external circumstances by setting itself apart from them. It also defined itself in relation to time: instead of being uprooted and moved each day, it becomes a means for planning for tomorrow. It is the manner in which the lacustrine towns arranged time, place, and circumstance as opposed to the particularity of their structure which offers an interesting analogy to the development of permanent research stations.

At the time of their discovery, some historians argued that the construction of the lacustrine towns evolved from the huts built on top or the rafts which where used by

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31 For a recent discussion of the Meilen discovery in the context of modern architecture, see Adolf Max Vogt, *Le Corbusier, the Noble Savage, Toward an Archaeology of Modernism* (Cambridge: MIT Press, 1998).

32 Gabriel Bonvalot, *En Asie Centrale, du Kohistan à la Caspienne* (Paris: Plon, 1885).

migrant Aryans to navigate rivers and the coast. When a sure and tranquil place could be found, they would moor the rafts in groupings near the shore.[33] But it was not the structural development of the lacustrine towns which was principally of interest to Garnier. Rather, it was the first instance in which man led what Edwards called "a totally artificial life." The habitation structured the separateness of man's occupation in time and space. The shelter the habitations afforded fostered the development of agriculture and animal husbandry which "liberated man" of the absorbing necessity of engaging each day in a search for his sustenance amid unknown terrain.[34] The evolution of the habitation was coeval with that of man's instinct for planning, the arranging of his domestic economy: "the prudent housekeepers conserve provisions for winter."[35] The work of a part of the year sufficed to assure sustenance for the whole year; thus the house and the industry attached to it raised the human spirit above immediate needs. The unknown is domesticated through the act of prudent housekeeping. The world beyond the home' sheltering confines and the prospect of tomorrow is made manageable. The household is the principal instrument deployed by the manager in protecting its occupants from want, by arranging things and laying them in store. Man's assured status opens the possibility of the free inquiry of his surroundings.

It should come as no surprise that historians debated whether these and other types of pre-historic structures were habitations and not food stores; both interpretations validate the central role of the prudent manager as a figure as central to the functioning of the

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33 Frédéric Troyon, *Habitations Lacustres des Temps Anciens et Modernes*, p. 250.

34 Comparably, Keller wrote taking care of herd meant "a regulated continuous activity, and a care for the future, qualities which are not to be found in the mere hunter," *The lake dwellings of Switzerland and Other Parts of Europe*, trans. John Edward Lee (London: Longmans, Green, Co. 1866), p. 479.

household as its sustaining fire. In the act of management, as opposed to the erection of any particular structure, represented a critical threshold in the nature of man's experience of time and place: "Not living from day to day, having an assured tomorrow, for the first time he could think of perfecting the conditions of his existence."[36] With this freedom, man perfects his gesture and speech, as Leroi-Gourhan referred to the manual creations of a material culture. As he notes, however, "the human act *par excellence* is perhaps not so much the creation of tools as the domestication of time and space, or, to put it differently, the creation of a human time and space."[37] As a result, the human was able to pass from the natural rhythms of the seasons, days, and walking distances, to a "rhythmicity regulated and packaged within a network of symbols—calendrical, horary, or metric—that turned humanized time and space into a theatrical stage upon which the play of nature was humanly controlled."[38] The habitation was not simply the product of man's industry nor was it only a response to his environment; rather, it created a separation in space and time between its inhabitants and the changeability of things. It was a implement in the process of domestication.

Remains from the lacustrine town were included in the "History of Labor" exhibit organized by the social reformer Frédéric Le Play at the Universal Exposition of 1867. The exhibit was meant to form a "chain" connecting "the most rudimentary engines of primitive

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35 Garnier, Ammann, *L'Habitation Humaine*, p. 65.

36 Ibid., p. 42.

37 André Leroi-Gourhan, *Gesture and Speech*, p. 313.

38 Ibid., p. 315.

man" to the most complicated machines of modern industry."[39] Le Play's social ideas reveal the prudent management of the home as a practice connecting the past and present. In his influential *Les Ouvriers Européens* (1855), Le Play sought to rationalize labor conditions by taking account of the needs, outlook, and domestic economy of families which be analyzed in a series of so-called "budgets." His analyzing these budgets turned on a paternalistic form of philanthropy calling on families to ensure their self-sufficiency through savings and prudence [*prévoyance*].[40] Le Play's conception of "social economy" was based on man's relationship to his environment, which by the nineteenth century could itself be considered a technological artifact.[41]

Le Play divided social existence into three categories: "Lieu, Travail, Famille." These corresponded to distinct family types which were themselves related to primordial forms of occupation: herding, fishing, and hunting. For the planner Patrick Geddes, these categories eventuated in his influential "valley section," which described connected geographic settings as distinct occupational environments.[42] Yet Le Play's ideas would have an airing at the Universal Exposition of 1889, placing them in physical and arguably conceptual proximity to Garnier's discussion of the origins of the household. Organized by his disciple Émile

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39 Charles Linas, *L'Histoire du Travail a l'Exposition Universelle de 1867* (Paris: Didron, 1868), p. 2.

40 As Walter Benjamin observed scornfully, these budget extended even to the lowly rag-picker, *Charles Baudelaire, A Lyric Poet in the Era of High Capitalism*, trans. Harry Zorn (New York: Verso 1979), p. 19–20, n. 25.

41 François Ewald, *L'Etat Providente* (Paris: Grasset, 1986), p. 92.

42 Rosalind Williams, "Technology, Progress, and Regionalism, Mumford as a Historian of Technology." in Thomas Hughes, Agatha Hughes, eds., *Lewis Mumford Public Intellectual* (New York: Oxford University Press, 1990), p. 52.

Cheysson, the "Social Economy" included a street of model worker's housing.[43] In the synoptic space of the Exposition, the first essays in housekeeping could be compared to the dormitories of modern industrial laborers.

Notably, one important source of historic evidence about the actions of the habitation's prudent manager was hardly apt, from an architectural point of view, to appear as part of Garnier's "History of Habitation." The *Kjökkenmöddings* or kitchen middens of Denmark excavated in the 1840s differed from the piles discovered in the Swiss lakes. Although they contained scattered remains of built structures, more importantly they revealed how the house took possession of its environment. Extending for hundreds of yards along the coast, the middens consisted of the shells of edible mollusks, the carapaces of crustacean, and broken animal bones which had accumulated over the course of a long period of occupation. Garnier mentions Quatrefages as among the archeologists who were able to "reanimate" these people's mores, beliefs, and industry by searching through the domestic objects, fishing implements, the hearth stones still filled with carbonized ashes, even the remnants of the "cabins" which were also found in the mounds.

What kind of traces did the first modern visitors to the coast such as Milne-Edwards and Audouin leave behind? Though their studies on the Chausey Islands involved a very large "consumption" of lobsters and crabs, they did not pass through the kitchen, as it were. Rather, after taking the animals from the basin they dug into the strand, the naturalists broke open their shells and examined them with the aid of "bizarre instruments."[44] Arguably the latter were the distant descendants of the implements also found in the middens. The mass of debris was itself an objective correlative for the *Archives*

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[43] Paul Rabinow, *French Modern* (Cambridge: MIT Press, 1989), p. 177.

[44] Quatrefages, *Souvenirs*, I, p. 28. (Italics in the original.)

which would one day record the research carried out in their wake in the confines of permanent research stations. Of the earlier period, however, Quatrefages's recollections and others like them are the only way of reanimating the nomadic phases of the tradition.

THE NOMADIC LIFE AND THE STATIONARY HABITATION
PART TWO

THE SCIENCE OF EMIGRATION

The migrations and patterns of settlement which determined the character of the national homes of Europe took on a different cast in the modern period in the movement to make the coast a suitable place of habitation. In fact, this movement involved a rigorous program of research into the nature of select places along shore. Yet the search for a home in the age of tourism turns the emigrant into a critic of predigested notions of place.

In 1861, Jules Michelet, author the monumental *Tableau de la France*, published *La Mer*, one of a series of "small books" of natural history, including *l'Oiseaux* (1856), *l'Insecte* (1857), and *La Montagne* (1868). In the realm of nature and the domain of its inhabitants, Michelet romanticized the development of human society and its collective actions. With *La Mer* in particular, Michelet gave literary expression to the animating forces of the most vast, mobile, and remote of the earth's three "oceans," the others being the sky and land. By his own account, the inception of *La Mer* dated to the long promenades he took along the coast of Normandy in the 1840s. In the intervening years, scientific knowledge of the sea increased greatly, and Michelet's understanding along with it. The encyclopedic yet highly selective use to which Michelet put scientific knowledge in his imagining of the sea's inexhaustible fecundity has been discussed elsewhere.[45] Here the point will be to examine how *La Mer* framed a dialogue between disparate regions through the acts of migration and acclimatization. The realization of the particularity of place depended on a subject's alternation between places; *La Mer* suggests the ways of knowing these places, which take on significance only through their difference.

The curious chapter of *La Mer* entitled "L'Habitation" laid out in words the plans for an ideal seaside villa; the method of determining its actual placement was discussed in the preceding chapter, "The Choice of Shore." The "choice" to which the title refers is that which confronts the infirm who seeks to cure herself through a change of climate. The earth is itself a doctor, he explains, each climate is a remedy. Medicine was becoming an "emigration, a choice of stations, habitations, weather, regimens, societies."[46] Arranging a proper route of emigration meant understanding the specificity of each station, its constitutive "individuality." At about this time, the authors of the influential *Villas, Maisons de Ville et de Campagne*, too, wrote of an emerging pattern of "emigration." It consisted of city dwellers seeking the open air and "green horizons" of the suburbs, and beyond them the stimulation of seaside resorts.[47] What both these waves of emigration shared with the naturalists who arguably were the first to develop a highly specialized taste for the shore

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45 See Michel Serres, "Michelet: The Soup," trans. Suzanne Guerlac, in Josué Harari, David Bell, eds., *Hermes, Literature, Science, Philosophy* (Baltimore: Johns Hopkins University Press, 1982), pp. 29–38; Roger Huss, "Michelet and the Uses of Natural Reference," in Ludmilla Jordanova, ed., *Languages of Nature, Critical Essays on Science and Literature* (New Brunswick: Rutgers University Press, 1986), pp. 295–321.

46 Michelet, Journal (August 22, 1860), cited in Jean Borie's "Notice," to *La Mer*, p. 361.

was a research into the individuality of the places along shore. In "L'Habitation," Michelet "built" in words a "prospective villa," in part as a criticism of the sham construction of much resort architecture. To be sure, the seaside villa offers numerous points of comparison with the development of research stations. The focus in this section, however, will be Michelet's discussion of the "science of emigration" and the "art of acclimatization." In bringing the prospect of a type of nomadic and fixed life up to date, it reveals a final set of terms for the study of the human ecology—its stations and habitations.

Maladies are rarely cured amidst the places in which they arise; seeking a cure entailed the infirm vacating their endemic circumstances. Michelet was among the writers to despair over the perfidious "domestic atmospheres" which threatened the family, especially in multi-family dwellings. In proposing a regime of emigration, Michelet began by addressing man's adaptation to his station. Man is like an oyster attached to a rocky bed, captive to his accustomed environment, he leaves it only at his own peril. He does not become free, he is not a truly cosmopolitan "inhabitant of the planet" until he masters the "art of acclimatization." In terms of the history of the sea, his views reflect the belief, which evolved from the time of his fundamental *Tableau de la France* (1833), that social and political action allow a people to overcome the fatality of place: the influence of soil, climate, and race. Yet here Michelet lets the reader into the family's foyer. He councils the family on the therapeutic necessity of displacing itself, or some family members, for the good of all. In entering into a discussion of the habitation, Michelet wrote of the need to make oneself at home in the new set of circumstances, called for by one's illness or rather one's cure.

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47 Léon Isabey, Leblan, *Villas, Maisons de Ville et de Campagne, composées sur les motifs des Habitations de Paris Moderne* (Paris: A. Levy, 1867), p. 2.

Chapter III

The chapter "Choix du Rivage," in which Michelet dispenses a lesson in medical topography, addresses a form of research on the nature of place, and the differences among them. The point of the emigration was not to discover untouched or unknown locales. Rather, it was calculated in advance to draw the greatest profit from those which were known to hold in reserve sources of "revitalization." For every malady there existed a "recommended station"; planning an itinerary thus meant knowing the specific character of each place. Yet occupied with the daily routine of the city, the emigrant did not have the "leisure" to study each locality in its particularity. She relied, then, on the panoply of guide books which constituted a veritable genre of therapeutic travel literature (290). However, these books often failed to indicate the "originality of the place" or to properly classify how each of them rated on the "scale of stations." When settling upon a destination, Michelet advised supplementing book knowledge with direct experience: "It is necessary to see, to observe one's self" (297). It was necessary to visit the actual places, to stay at each and judge its eligibility as a habitation. This point is worth emphasizing: the emigrant ensures his well-being only when he takes into account the place in its originality; there is an infinity of local circumstances which "one cannot guess at from afar" (295).

The infirm's transition from the circumstances and places in which an illness originated and the station sought as a cure was itself a risky affair. Having become morbidly habituated to the city, "a totally interior climate," sudden exposure to the maritime air could prove a debilitating shock. Michelet warned that the very speed of railroad connections was itself "anti-medical."[48] The failure of the emigrant-passenger to acclimatize as the train passed each hour through a new climate resulted in a state of nervous agitation. The train created an artificial proximity of places; the train carriage itself sheltered its passengers from the onrush of space. Michelet juxtaposed the phenomenon of rapid transit to the month it took for Madame Sévigné to travel from Brittany to Provence: "she crossed bit by bit and by managed degrees the violent oppositions of those two climates." The transition between climates must be handled delicately; it is part of the medical regimen. But diminishing the opposition of climates does not diminish in any way the differences among them. Different climates were joined in medicine of emigration by virtue of their opposition.

The nature of difference—as opposed to an underlying uniformity—structured Hippocratic notions of the relation between the environment and culture, institutions, traits, and even habitations of peoples living in diverse places.[49] To suggest the persistence in the nineteenth-century geography of the elemental triad of *Air, Water, Places* in no way diminishes the ascendance of the modern concept of the "milieu."[50] Hippolyte Taine ascribed to "race, moment, and milieu" a constitutive role in the formation of national and artistic sentiment. The milieu also played a role in Vidal's idea of modes of life, even if it did not have a deterministic influence. He concludes the *Tableau* with a study of the "routes" which connected places and distributed resources and were ever changing the

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[48] On "domestic atmospheres" see Alain Corbin, *The Foul and the Fragrant*, trans. Mariam Kochan (Cambridge: Harvard University Press, 1986), pp. 164–170.

[49] Clarence Glacken, *Traces on the Rhodian Shore* (Berkely: University of California Press, 1967) p. 85.

[50] An important study is Georges Canguilhem, "Le Vivant et son Milieu," in *La Connaissance de la Vie* (Paris: Vrin, 1992), pp. 129–154.

relation of man to his native soil.[51] The emergence of a biological concept of the milieu in the writings of Lamarck and how it filtered into these strains of discourse, if in fact it was conceptually prior to them, is a complex issue which has been discussed elsewhere. The point here in emphasizing the nature of difference particularly as it emerged in Michelet's discussion of the originality of place is to reveal an aspect of the historic understanding of human ecology. Michelet's consideration of the literature of medicalized travel, the criticism of which takes the form of traveling to the places themselves to judge claims made for them, can be read with regard to the significance of space, and how it was to be understood.

Scientific geography, Roland Barthes wrote, can be considered a kind of obliteration, a censorship which objectivity has imposed on signification. Notably, he recalls the Greek concept of the *oikoumene*, or the habitable part of the earth. The *oikoumene* referred primarily to the concrete components of place; it shares its root term *oikos*, or the household, with "ecology" and "economy." As Clarence Glacken observed, it expressed a conception of terrestrial unity which implied the inequality of environments and the differences among them; and, by implication, to the unequal distribution of peoples and to the boundaries that might divide off a densely inhabited from a desolate region.[52] Yet even in the Hellenistic tradition, the notion broadened from a geographic to a cultural concept. The impact of the pre-modern understanding of space is evident in Barthes's claim that in its earliest manifestations, geography constituted a veritable discourse, with its symmetries, its oppositions of sites, with its syntax and its paradigms. "A map of the world by Herodotus, graphically realized, is constructed like a language, like a sentence, like a poem,

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51 Vidal de la Blache, *Tableau de la Géographie de la France* (Paris: Hachette, 1905), p. 377; see also in this regard, George Marsh *Man and Nature; or Physical Geography as Modified by Human Action* (1865).

52 Glacken, *Traces on the Rhodian Shore*, p. 17.

on oppositions: hot countries and cold countries; then on the opposition between men on the one hand, and monsters and chimeras on the other."[53] Of course, Michelet does not discuss monsters and chimeras in *La Mer*, at least not in the "choice of habitation" section. Rather, the mysterious contagion of life in the city is juxtaposed to a panoply of healthful places along shore.

In his discussion of the "prospective villa," Michelet turns from the choice of shore to the "grave and capital" question of the choice of a habitation. Michelet disparaged the stylistically eclectic houses which were out of place along the coast. Although they were built with the purpose of taking advantage of the individuality of place, they were copied from types in "contradiction to our climate."[54] To be sure, the specimen books put out by promoters of suburban and country houses were one source of inspiration for these "cardboard cottages." César Daly, editor of the *Revue Générale d'Architecture* and author of an important work on suburban architecture, noted that the labels which designated these houses indicated some sort of international influence without specifying the distinctive character of each of them: cottages (English); chalets (Swiss or German); villas (Italian).[55] The exuberance and excess of the style in some resorts was such that in postcards of the period the people promenading along the strand glance to the houses and not to sea.[56]

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[53] Roland Barthes, "Semiology and Urbanism," trans. Richard Howard, in Joan Ockman, Edward Eigen, *Architecture Culture 1943–1968* (New York: Rizzoli, 1993), p. 413. On the notion of the "oikomene," see Augustin Berque, *Être Humaine sur la Terre* (Paris: Gallimard, 1996).

[54] The Villa Sucrouf at Paramé was actually realized following Michelet's word picture, see Nathalie Loyer, Jérôme Sené, "Naissance des premières stations balnéaires," *Monuments Historiques* 1 (1978), p. 44.

[55] César Daly, *L'Architecture Privée au XIX^e Siècle, sous Napoléon III, Nouvelles Maisons de Paris et des Environs* (Paris: 1863), p. 10.

[56] Nathalie Glon, "Villa Balnéaires de la Manche," *Monuments Historique* 1 (1978), p. 40.

Michelet's impression was that these "kiosks," as he called them, were out of place in face of the sea.

He did not object to these habitations on stylistic grounds only, but also on ethical grounds. They were not designed for the well being of the emigrant, but were put up in order to take advantage of her; they were the product of speculation. While property owners built for themselves good and solid houses, they built "absurd chalets" for the "poor ill-ridden." The latter were at the landowners' mercy. The chalets were absurd in that they were shockingly out of place. The enormous eaves which in the Alps sheltered the chalet from snow, in Normandy blocked out the sun, depriving its inhabitants of a primary sources of well-being. As Jacques Gubler wrote, for Viollet-le-Duc the chalet was itself a sort of "natural phenomenon," embodying the very "micro territory" of which it was a part.[57] But Michelet was quick to indicate that chalets built along the shore did not have the protective cover of moss like Swiss chalets, but were exposed, and everything out of joint. They "mocked" their tenants. But it was not only the chalets which were wanting. Having an appearance of luxury on their façade, seaside villas did not provide the comforts within their flimsy walls. It is worth mentioning that in his discussion of the habitation it is the wife who ails, and the husband who suffers from her absence in the city. The other alternative, the homes of fishermen and even townspeople were often dark and uncomfortable. Though serving as home to the local population, for the lodger they were themselves the possible sources of untold maladies.

Having ruled out the homes of local inhabitants as improper, and the speculative houses as "dangerous traps," Michelet limns the prospective villa as a dwelling perfectly in

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57 Jacques Gubler, "Viollet-le-Duc et l'Architecture Rurale," in Jacques Gubler, ed., *Viollet-le-Duc Centenaire de la Mort à Lausanne* (Lausanne: Musée historique de l'ancien-Evêché, 1979), p. 115.

accord with the originality of place. As such, he begins from the elemental material facts of shelter. In every shelter two things must always be seen to in advance: fire and water. Near the sea, he writes, sources of fresh water were rare. Overcoming this problem was primarily a matter of planning, of laying in provisions. The imagery of the fire touched on the intimate life of the family. Here Michelet writes in affecting terms of the parent placing a child in front of the fire to regain its warmth before going to bed. Above all, a home required a good fireplace which was not threatened by the winds which caused the speculative houses to "tremble." Trembling was itself a symptom of houses which were either deracinated (the absurd chalet), or those which were never planted to the ground (the "absurdly light" speculative house). It was associated in Michelet's imagery with the other chief defect of these house: the brusque changes in temperature to which their inhabitants were subjected. Where these houses exposed their inhabitants to the elements, the prospective villa provided a shelter. As such the villa was not closed in upon itself, nor did it exist solely to impress promenaders on the strand. Rather it allowed its inhabitants to organize their daily life in relation to changes in weather, times of day, seasons of the year.

The design of the prospective villa was original. Crescent-shaped in plan, its convex façade offered its inhabitants a "varied panorama of the sea" (299). The facade formed a solar-hemicycle, over the course of the day the sun passed through each of the windows. In the typical country dwelling, the placement of windows was calculated to take advantage of the pleasing aspect of well-designed views. Yet the view from Michelet's villa contributed to the inhabitant's sense of a sheltered interior. The foundations and walls of the convex, seaside of the villa, he wrote, needed to be stable enough to withstand the fiercest storms. "Storms" was the title of the chapter in which Michelet explained the physics of the sea, including the "circulus" which stirred this thick "soup" of life. Reflecting on the happy contrast of the storms which raged outside to the calm found inside the villa, its inhabitants remark: "How well one is here!" The villa is sedated, so to speak, based on what Michelet called a "reassuring foundation" [*assise rassurante*]. Even as the waves swell to the "height of Notre Dame" in Paris, the house instills in its occupants the sense of well-being. The villa manages the particularities of the chosen shore and made them into the elements of a habitable place.

The concave part of the villa formed a shelter within the shelter. Facing inland, it was a retreat from the sea itself. In the inner courtyard which was "embraced" by the sides of the crescent, was to be found the small flower bed of the lady of the villa. Flowers growing by the sea represented for Michelet the very essence of care, of taking "precaution" to ensure their growth. Returning to the edifice, the court itself was surrounded by a covered gallery for bad weather, formed by the overhang of the first floor. On those days when the beach was not tenable, the lady of the houses was occupied in the court, surrounded by life: flowers, bird-cage, and a small basin filled with sea water, where each day she could put "her discoveries, the little curiosities" brought to her by fishermen. There, "situated in a well-sheltered way," she takes joy in tending her enclave. She, too, is looked after. Her child who stays with her during her cure recalls the home she has left behind; with him, she has the thought that someone there is counting the days until she returns. The villa is not luxurious, it consists of the "essential, the simple, the comfortable and nothing more" (300). The enjoyment of the villa comes from the promise of well-being and the temporary suspension of housekeeping; instead she arranges things in relation to the dwelling. The villa's convex side encompasses the strand and the rejuvenating elements of the sea, while in the court she gathers precious examples of life which benefit from her "protection."

Chapter III

THE NOMADIC LIFE AND THE STATIONARY HABITATION

PART THREE

THE FLYING STATION

Lacaze-Duthiers considered the hardship and "loss of time" involved in nomadic life as the price to be paid for confronting "the very face of nature." The voyage of observation was formative of the self, a *Bildungsreise*: in coming to terms with his external circumstances the naturalist was forced to discover his own inner resources. The element of suffering and uncertainty was intrinsic to the moral development of the young naturalist, forcing him to appreciate the opportunity for work. However, in Lacaze-Duthiers's public telling of his journeyman years, typically including his improbable lodgings and improvised equipment, was to be found the rationale for founding permanent laboratories. These stories circulated among naturalists, for whom they served as arguments for the "utility" of establishing laboratories on the model of Roscoff.[58] Lacaze-Duthiers himself fretted that the relative comfort of his station might diminish the ardor of young naturalist's who were not forced to pay with their own efforts for the opportunity to carry out research. But more

58 Jean Joyeux-Laffuie, *Discours sur l'étude des animaux marins et l'utilité des laboratoires maritimes, prononcé le 3 novembre 1888 à la rentrée solonelle de faculties* (Caen, 1888), p. 7.

troubling still was the possibility that a permanent station would also cause the horizon of research to become fixed.

There is evidence in the copious writings that the house-proud Lacaze-Duthiers devoted to his stations of an ambivalence about foregoing aspects of the nomadic life. In an "analysis" in the *Archives* about the portable research station of the Dutch Zoological Society, Lacaze-Duthiers deployed for the first time the rhetoric of his station as a household. The station is revealed not merely as the end result of a period of exploration. Rather the maintenance of the household is seen as intrinsic to the means of carrying out research. Yet Lacaze-Duthiers's report on the mission of the naturalist Hermann Fol aboard the research vessel *Aster* showed that these means and ends could not always be so easily separated. Both examples represented possibilities of research which Lacaze-Duthiers set aside as he developed Roscoff into an "impressive and attractive property."[59] Through the examination of the these alternatives, Lacaze-Duthiers himself would come to understand what was at stake in taking possession of a chosen place in the field of research.

The story of the French-born Genevan Hermann Fol was worthy of the combined peril and possibility of one of Jules Verne's extraordinary voyages. Fol was first taken in by the "charm of the sea" during an expedition to the Canary Islands led by his teacher, the apostle of evolution Ernst Haeckel. The purpose of their voyage was to study the microscopic organisms which thrived in the warm coastal waters of Lanzarote island.[60] During his student years, Haeckel himself accompanied the famed physiologist Johannes Müller on a collecting trip to Helgoland. Quatrefages would go so far as to claim that Müller

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[59] Lacaze-Duthiers, "Laboratoire de zoologie expérimentale de Roscoff, comte rendu des améliorations et des travaux de 1874 a 1878, *AZEG*, VI (1877), p. 312.

[60] Maurice Bedot, "Hermann Fol, sa vie et ses travaux," *Revue suisse de zoologie et annales du Musée d'histoire naturelle de Genève* t. 2 (1894), p. 2.

considered time lost the years prior to his discovery of the organisms which thrived along the shore.[61] Such opportunities were not to be lost by the next generation: not only did Helgoland eventually became the site of a laboratory and aquarium, but Fol's fellow student Dohrn founded the Zoological Station of Naples. Fol himself established a research station with a group of Russian naturalists in a former galley in the Mediterranean port of Villefranche. He would eventually be evicted from the station as a result of what can only be described as a domestic squabble among its resident naturalists. For Lacaze-Duthiers, who was kept apprised of the regrettable Villefranche affair by all the parties involved, Fol's voyage represented not only new found freedom but an end to housekeeping. Or at least it marked a reversion to its nomadic state.

In preparing to carry out a mission he received from the French minister of public education to study the distribution of sea sponges throughout the Mediterranean, Fol transformed the *Aster* into a laboratory and mobile habitation. As Barthes has written of the vehicles in Verne's fiction, the ship was "a habitat before being a means of transport."[62] They allowed the traveler to move through ever new regions while satisfying the regressive desire to close oneself up. The imagination of travel corresponded to an exploration of enclosure, the delight in the finite.[63] This experience of closure must be read into Lacaze-Duthiers's discussion of Fol's voyage. Where Lacaze-Duthiers savored the fact that Fol was the sole master of his ship and could direct it to ever new horizons, his comments displace the notion of closure from the ship itself to the ports and calm harbors such as where his

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61 Quatregages's "Discours prononcés aux Obsèques de M. H.-Milne Edwards," p. 8.

62 Roland Barthes, "*Nautilus* et Bateau Ivre," in *Mythologies* (Paris: Éditions du Seuil, 1957), p. 90.

63 Ibid., p, 62.

own stations were established. As Lacaze-Duthiers described the conditions in which Fol would carry out his research:

> Après avoir dragué, pêché et recueilli les matériaux de ses études, il voulait ailler mouiller dans un port sûr et tranquille, ayant autour de lui, baignant dans l'eau, ses objects d'étude, habitant et travaillant à bord de l'*Aster*; il voulait se suffire à lui-même. Et lorsqu'il aurait ainsi épuisé une localité, il se serait occupé de chercher une autre station, appareillant sans nouveaux préparatifs et recueillant, pour aller mouiller dans un autre milieu tout aussi sûr et aussi tranquille, où ses études eussent été continuées dans les meilleures conditions.[64]

Fol was never out of his element, but rather purposefully adrift: he was abroad but never away from home. As he cruised the Mediterranean his research was not so much interrupted as continued; at each location he had all he needed at the ready. Where he anchored depended entirely on the conditions of the sea and the richness of the fauna. And according to Lacaze-Duthiers, Fol made use of "time lost to transit" modifying instruments with which to carry out fine observations of his specimens.[65]

As we contrast the *Aster* to fixed stations, is it equally possible to speak of a mobile versus a fixed point of view? Incidentally, just as Fol set out to study the distribution of sea-sponges in the Mediterranean, the naturalist Emile Topsent was producing a photographic album of the sea-sponges of the Banyuls region.[66] Fol's ambition was to make a survey of the Mediterranean which was "complete from all points of view." Fol was

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64 Henri de Lacaze-Duthiers , "Hermann Fol," *Archives de Zoologie Expérimentale et Générale* 3e série, t. II (1894), p. 11.

65 Lacaze-Duthiers, Fol, p. 11–12.

66 Louis Boutan, "L'Instantané dans la Photographie Sous-Marine," *AZEG* ser. 3, t. 16 (1898), p. 302.

entirely free to direct his own movement, but his opportunities for collecting were limited by the distribution of the sponges themselves. By constrast, at stations such as Banyuls, opportunities for observation were pre-arranged; Topsent simply set his camera up in the aquarium and photographed the specimens which interested him. But it is equally true that what was placed before his camera was pre-selected. Leaving aside the specifics of this comparison, Fol's work in photography and microscopy warrant a brief excursus on the subject of picturing practices. For Fol, being in the right place at the right time—itself a question of distribution—was not merely a necessary condition for producing an image, but was constitutive of the form to be captured on film.

A founder of the Geneva Photographic Society, Fol pursued the technological developments, especially rapid emulsion, which were extending the naturalist's visual scope in the spatial and temporal dimension. To this end, Fol invented the "repeating photographic rifle" to capture objects in movement. The camera was not a means to classify the fixed order of things, but to document how they changed over time: his pictures have a before and after. The rifle was designed so that it could be folded up and reduced to a size convenient during zoological expeditions.[67] In fact, it was not the camera but the weight of the photographic plates that Fol saw as an encumbrance. Yet the mobility of the naturalist was only one side of Fol's equation, the other being the "animals in movement" which the camera was meant to arrest. In this regard, Fol criticized Étienne-Jules Marey. Though Marey was able to trace movement in a perfectly continuous manner, his apparatus, which was housed in a "rolling darkroom," required a "costly" and "spacious" photographic "station," consisting of a carefully prepared black screen against which his

[67] Hermann Fol, "Sur un appareil photographique destiné a prendre des poses d'animaux en mouvement," *Archives des sciences physiques et naturelles*, 15 (1886), p. 520.

subjects were cast in stark relief.[68] Given the portability of the photographic rifle, Fol was attentive to how the cameraman's "point of view" was to be arranged with regard to the changing terrain through which he moved and the subjects which presented themselves.

Fol objected that Marey's camera remained at a "fixed post" throughout each motion study, determined by the focal length between the camera and the black screen. The variable focus of his rifle, by contrast, allowed Fol to track his subjects through open space. With his finger poised on the trigger, the operator only had to wait for the "opportune moment" to present itself. Where Marey structured a stationary point of view—immobile except along single axis—from which to record a range of continuous movements over time, Fol's rifle produced "isolated photographs" of whatever objects, moving or still, the naturalists came upon. Marey's camera only worked with "animals which submit to the demands of the experimenter," which would not stray from its point of focus.[69] Fol's visual opportunism deprived him of any fixed point of reference, the pose was definitive of the unique circumstances the photographer found himself in. Perhaps this accounts for the chaotic heterogeneity of the motion studies Fol carried out during the three "promenades" he made with his rifle: a group of young girls jumping rope, unaware that they are being photographed; a dog scratching itself; a pigeon leaving its roost, *inter alia*.[70] The spontaneity inherent in such picturing practices, however, is the seeming opposite of the regularities of time, space, and action which structured his work in microscopy.

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68 Ibid., p. 519. See Étienne-Jules Marey, "La Station Physiologique de Paris," *La Nature* no. 536 (September 8, 1883), p. 229; Albert Londe, *La Photographie Moderne* (Paris: G. Masson, 1888), pp. 262–63.

69 Hermann Fol, "Sur un appareil photographique destiné a prendre des poses d'animaux en mouvement," p. 519.

70 Ibid., p. 525.

The very name *Aster* recalled Fol's experiments in envisioning the evolution of form in time. Asters were the star-like fibers which radiated from so-called "kinetic centers" during the division of sea urchin eggs. Underscoring his attempt to find order in movement, the title of Fol's work on the Asters, "Le Quadrille des Centres" (1891), takes its name from a type of dance.[71] Where music set the tempo for a dance, the temperature of the water in which the eggs were kept determined the rate of cell division.[72] Fol noted that his time markers had no absolute value, but that the proportional duration of individual phases remained constant, no matter the overall rate. This points to the underlying tension in the paper between form and movement, structure and development. Fol explained that the intermittent symmetry of the centers was a "circumstance" which allowed the observer to know that a certain process was underway. Structure, as such, was anatomized into changes in form; form itself was transitory. Throughout his influential work on microscopic technique, Fol identifies elements not by their structures, but by episodes: as a "time-point," "change-point," "transition stage."[73] Accordingly, the article's text was punctuated by time-markers in the division of the egg, the staggered series of images, each an event in the process of division, were connected through Fol's narration.

Returning to the view from the *Aster*, the ship itself was the naturalist's chief instrument of observation. It effaced the distinction between journey and dwelling as it moved from station to station, each one of them presenting unique circumstances in which to conduct research. When the opportune moment passed, he took up anchor and moved on.

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71 Hermann Fol, "Le Quadrille des Centres, un Épisode Nouveau dans l'Histoire de la Fécondations," *Archives des Sciences Physiques et Naturelles* t. XXV (April 1891), p. 393–420.

72 Hermann Fol, "Contribution à l'histoire de la fécondation," *CRAS* t. 112, no. 16 (April 20, 1891), pp. 877–879.

Much to Lacaze-Duthiers's personal regret, the *Aster* disappeared amid "circumstances and causes which still remain a mystery."[74] Lacaze-Duthiers last saw Fol when the latter passed through Paris on his way to outfit the ship in Le Havre. Lacaze-Duthiers warned him of the perils of navigation. In the notice on Fol which appeared in the *Archives*, Lacaze-Duthiers juxtaposed Fol's innovations in the realm of image making with his own skepticism about the "illusion" of safety which Fol took with him to sea. In imaging Fol's loss at sea, Lacaze-Duthiers could commend himself on his own "prudent" choice of remaining on shore.[75] However, it was not a storm which spelled the disappearance of the *Aster*, but rather life aboard ship. On the basis of all available evidence, Fol's imperious character caused the crew he chose too hastily in Le Havre to mutiny. The editors of the *Revue de Photographie*, where Fol often published, made an appeal to its subscribers living in maritime cities who might have some information of his whereabouts. Desperate for answers, they speculated that the crew probably disappeared to Africa.[76]

Lacaze-Duthiers was not looking for a ship. As he later wrote to Alexander Agassiz, who organized the great voyage of the research vessel *Challenger*: "Me, I am riveted to the ground and cannot distance myself from my stations."[77] It was difficult for naturalists to remain "embarked" for a long time"; the case of Fol having shown that being embarked was in some sense synonymous with uncertainty. Notably, Lacaze-Duthiers's

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73 Hermann Fol, *Lehrbuch der vergleichenden mikroskopischen Anatomie mit Einschluss der vergleichenden Histologie un Histogenie* (Leipzig: Wilhelm Engelmann, 1884), p. 266.

74 Lacaze-Duthiers, "Hermann Fol," p. 13

75 Hans Blumenberg, *Shipwreck with Passenger, Paradigm of a Metaphor of Existence*, trans. Steven Rendall (Cambridge: MIT Press, 1997), p. 26.

76 "La disparition du Dr. Fol," *Revue de Photographie* no. 7 (July 1892), pp. 327–329.

announcement in the *Archives* of Fol's disappearance offers a first glimpse at the meaning of the foyer as a sheltering interior. Paying a visit to Lacaze-Duthiers in Paris in order to discuss his plans, Fol was like the traveler who enthralls his hosts with his experiences of the seas and foreign lands.[78] The doubling which appears in Lacaze-Duthiers's description of the subsequent voyage, the naturalist seeking "a sure and tranquil port," and then leaving it again to seek out "another milieu equally as sure and tranquil," speaks of the primacy of the station itself as a point of safe return. Indeed, it was hoped news of Fol would turn up in a maritime city. Five years after his disappearance, Fol was legally declared lost and his final testament executed; all his instruments and equipment were left to Lacaze-Duthiers for use at his stations. The legacy of Fol's nomadic life became part of the furnishings of Roscoff and Banyuls which he "often loved to visit."[79]

MAKING PROVISIONS FOR THE STATION

Originally, Lacaze-Duthiers regarded the station of Roscoff as little different from the *Aster*: "The laboratory would have been able to be transported from locality to locality and thus would have been established the zoological inventory of our coasts."[80] Roscoff was not conceived as a building as such but as a "central station" that would supply the provisions for "scientific caravans would go out to explore the coast in an ever wider

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77 Lacaze-Duthiers letter to Alexander Agassiz (Paris, December 22, 1887) Harvard, Museum of Comparative Zoology.

78 Hans Robert Jauss, *Aesthetic Experience and Literary Hermeneutics*, trans. Michael Shaw (Minneapolis: University of Minnesota Press, 1982), p. 280.

79 Lacaze-Duthiers, "Sur les Laboratoires de Roscoff, Banyuls et les Archives," *AZEG* ser. 3, t. VI (1898), p. 32–33

80 Henri de Lacaze-Duthiers, *Enquêtes et Documents relatifs à l'enseignement supérieur, Ministère de l'instruction publique et des beaux-arts, laboratoire maritimes* XIII (Paris Imprimerie

radius."[81] The meaning of station here is close to that of an *étape,* a halting-place, or the distance covered in a day's march. The station was a fixed point—a sure and tranquil port—to which these caravans of naturalists could return after surveying ever widening regions along the coast. But what if the station itself joined the caravan and became a mobile structure? Where the Aster was a means of connecting places at sea, at this period a variety of portable stations were constructed which allowed naturalists to establish themselves each year at different maritime towns or stretches of coast. The fact that these stations consisted of demountable structures provides only half the explanation of how they proved to be effective means of research. The other half is to be found in the person of the manager who played an important role (separate from research) in seeing that the laboratory was properly supplied and situated at each new station. His job was to turn any given site into a place of research.

As if to justify the foundation of Roscoff as a permanent station, Lacaze-Duthiers printed in an early issue of the *Archives* an analysis of the so-called Flying Station of the Dutch Zoological Society (fig. 3.5). His intention for doing so was to correct what he perceived to be the sometimes false idea of Roscoff promulgated by the numerous articles published by visitors to the station. But the curiosity of the Dutch Station was that as a portable structure it represented the path not taken at Roscoff. As the only research station apart from Lacaze-Duthiers's own Roscoff and Banyuls ever to be discussed in the *Archives,* it served as an object lesson in why a fixed station was ultimately preferable to the nomadic life. During his visit to Roscoff in 1876, the Belgian naturalists Léon Fredericq translated the report of the portable laboratory's first year of activity from the German. In fact, Fredericq

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nationale 1884), p. 3.

81 George Pruvot, "Henri de Lacaze-Duthiers," p. 40.

included a warm description of the hospitality he received at Roscoff in the first chapter of his *Lutte pour l'Existence* (1889), which nominally described animals' battle for their respective niches. His "analysis" established a basis, albeit unsystematic, for comparing the different types of establishments occupied by naturalists. As will be discussed, Lacaze-Duthiers even considered his second research station, at Banyuls s/m, as a control group for his experiment in housing naturalists at Roscoff.

Leaving aside for a moment Lacaze-Duthiers's particular framing of the Dutch station, its planning and operation are highly indicative of a structural moment in the passage from nomadic to fixed habitation. The Société zoologique des Pays-Bas voted in December 1875 to create a national zoological establishment along the shores of the North Sea. Yet unable to find a suitable permanent location, the Society decided to construct a laboratory made of wood which could be demounted and moved from one point on the coast to the next. The structure allowed naturalists to "study at leisure" the flora and fauna of the North Sea.[82] What made the station "a totally unique type," was precisely its liberty of movement.[83] This capacity inevitably led to the question of how stations of either type were necessary and where—or between what places—they were to be located. In other words, how were stations to be distributed along the coast. Instead of creating a multitude of small laboratories which were destined to "vegetate sadly," one outside observer noted, would it not it be better to construct one or two mobile stations which could be placed when and where they were needed?[84] Part of the answer to this question can be found in the first

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82 "Une Station zoologique dans la Mer du Nord," *La Nature* no. 190 (January 20, 1877), p. 121.

83 A. Buisseret, "Les stations zoologiques des bords de la mer," *Revue des Questions Scientifiques* t. 25 (1889), p. 48.

84 H, Coupin, "Sciences, Zoologie, Les Laboratoires de Zoologie Maritime," *Revue*

yearly report of the Dutch station, which began by questioning the nature of place and situation. Hoek, who was its author and overseer of the station, understood that the coast's topography was irregular and its resources distributed unevenly. When considered along with the station's own resources and internal organization, the report serves as a balance sheet of the costs and benefits of mobility.

Abstracting from the concrete realities of place, Hoek described a "field of work" on the surface of which could be plotted points—the actual position of the laboratory one of them—between which extended lines of contact:

> There is hardly a point in the kingdom from which one, given today's connections, one cannot reach the strand within a few hours, except that only in certain exceptional cases is one successful in finding some point on the coast which is an area suited both for zoological researches and also for adequate opportunity to bring the required materials.[85]

With the advances of rapid modern transportation, distance ceased to be what separated disparate places, becoming instead one of the variables in the relationship between them. On a local level, the question of who one's neighbors were was an important consideration, considering naturalists attached to the station had to find housing for themselves wherever it was placed. Where the rents around balneal stations such as Scheveningen and Zandvoort were too expensive, seaports such as Nieuwediep were too heavily trafficked. In addition, the station had to be in proximity to municipal gas lines so that its heating system

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Encyclopédique des Sciences (n.d.) pp. 42–50.

85 P[aulus] P[etrus]. C. Hoek, "Bericht ueber die zoologische station der niederlaendischen zoologischen gesellschaft," *Niederlandisches Archiv fur Zoologie* b. III (1876–77), p. 309.

could be operated.[86] The point irreducibly marked a place between established places. The station had to produce its own area of research.

Following Hoek's initial comment about how modern means of communication brought places to together, for Lacaze-Duthiers and other naturalists finding the proper site for a permanent station was often a question of setting it apart from other developments along shore. In part this was done for them by the elective affinity which drew different elements of society to a variety of places. Serving as they did as the extra-mural branches of urban faculties, however, the proximity of station to those faculties mattered.[87] In explaining the choice of Wimereux for his laboratory, Giard wrote of the need of being far enough, but not too far away. When the right place was chosen, the naturalist could enjoy the calm of the country and the peace and quiet necessary for serious study while at the same time taking advantage of the resources offered by the proximity of a large town: inexpensive sources of transportation and ease in obtaining equipment and provisions which otherwise constitute an "inconvenient baggage" when they have to be gotten in advance and taken along to far off places.[88] If modes of transport could indiscriminately connect people, the nature of place sorted them out. Lacaze-Duthiers spoke in similar terms of Roscoff as being far but not too far from Paris. While the length of transit proved a modest inconvenience, the station's distance prevented it from becoming a resort

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86 Adrien Dollfus, "La station zoologique de la société Néerlandaise de zoologie," *Feuille des Jeunes Naturalistes* XIX (Nov. 1, 1888), p. 18.

87 For a discussions of the shore's "accessibility" during this period, see Bernard Lepetit, *Chemins de Terre & Voies d'Eau, Résaux de Transports Organisation de l'Espace* (Paris: Éditions de l'École des Hautes Études en Sciences Sociales, 1984), p. 111.

88 Alfred Giard, "Laboratoire de zoologie maritime à Wimereux," Association Française pour l'Avancement des Sciences, *Compte Rendu de la 3me session 1874* (Paris: Secrétariat de l'association, 1875), p. 70.

destination, threatening the tranquillity necessary for work.[89] In the case of the Dutch laboratory, however, these modes of transportation were not simply used to convey researchers but to transport the laboratory itself.

The relations in (and with) place established by the portable laboratory was underscored by a caption which appeared in *La Nature*: "Station zoologique transportable, telle qu'elle était installée à Helden (Pays-Bas), en juillet 1876."[90] The 'such as it is' character of the image reflected the fact that each season the station would figure as a foreground figure against a series of successive backgrounds, each identified by a corresponding place and date: Zéelande (1877), Ter-Schelling (1878), Niuwe-Diet (1880), etc. The image of the flying station is temporal as well as temporary. The twinning of place names to identify train lines bespoke new contiguities in time and space which "today's connections" brought into being.[91] The portability of the station depended on these connections—it may occupy a station along the line. With its flag pole resembling a mast and its louvered wall openings, the building appears to be rigged in accordance with the ever changing conditions of the field. While July proved quite favorable, work stopped at the end of August due to the persistence of bad weather.[92] On August 29, 1876, the resident commissioner ordered the laboratory to be dismounted. By the following evening it was packed on a baggage car of a Dutch railroad train on route to Leyden, where it was stored

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89 Lacaze-Duthiers, "Leçon d'Ouverture du Cours de Zoologie a la Sorbonne," *AZEG* t. III (1874), p. 3–4.

90 The images was directly based on the one in Hoek's report; the transformation is very typical of the signature engraving style which is far more stark than the hand drawn.

91 See Wolfgang Schivelbusch, *The Railroad Journey* (Berkeley: University of California 1977), pp. 38–39.

92 "Une Station Zoologique dans la Mer du Nord," p. 122.

in the attic of the zoological laboratory. It remained there for the winter along with storage cases containing specimens sent back from the field.

What did the portable station itself consist of and what did it contain? In its planning, the commissioners observed that at least temporarily a wooden shed would best serve its goals both because of its low cost as well as because it could be easily assembled and disassembled. The simple structure consisted of a small entry room that housed a number of portable aquaria, basins being too heavy to transport, and fishing equipment. The main room had seven large windows, shielded by retractable canvas sun-screens, offering a great deal of light for microscopic researches. Behind of each of them was a work table secured to the framework of the building. The portable station built by the Bohemian Zoological Society improved on this arrangement with shutters which could be removed and "transformed" into two tables, each accommodating three workers.[93] The benches on which the naturalists sat also served as coffers during transport. Two more movable tables occupied the center of the room; a set of shelves and three large armoires stored instruments and materials—naturalists were expected to bring their own microscope. Packing the station's library involved careful selection of reference works describing the fauna of the region the station presently occupied. A third small room, seen projecting to the right of the side, was reserved for the director of the station.

The laboratory's adaptability was not just an artifact of its prefabricated construction; rather its prefabricated construction allowed it to be deployed according to circumstance. Fredericq noted that the laboratory could be loaded unto a wagon and be reassembled within a day's time. As with the Bohemian station, weight and time of

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93 Antoine Fritch, "Notice sur la station zoologique volante du comité pour l'exploration de la Bohème," *Compte-Rendu des Séances du Congrès international de zoologie de France* (Paris: Société zoologie de France, 1889), p. 97.

assembly were the chief considerations in the structure's design. In many respects the Dutch station resembles the "The Manning Portable Colonial Cottage for Emigrants" which were produced in England beginning in the 1820s.[94] Designed for their ease of transport, Manning's cottages provided a shelter that was both comfortable and "secure from thieves and from vermin" immediately upon the immigrants' arrival in port.[95] Variants of the cottage, which responded to the need for "'instant' temporary housing" were produced for settlers on the American prairie and especially for those headed to San Francisco during the Gold Rush of 1849.[96] An ardent proponent of botany and natural history, the landscape writer John Claudius Loudon wrote that Manning's cottages were suitable to tourists and scientists alike. Fitted with wheels, they could be used as "moveable residences" and even grouped together into cooperative ambulatory societies.[97] "We do not say that the same comforts and advantages would be obtained so economically as in a fixed locality." But this arrangement allowed a family or families to alternate between the north of England during the summer and to the south during the winter, or even to set up in the suburbs of a large town.[98] The structures reappear with slight modification in a wide variety of climates on varying conditions of inhabitation.

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94 Gilbert Herbert, "The Portable Colonial Cottage," *JSAH* vol. XXXI, #4 (1972), p. 261.

95 John Claudius Loudon, "Design LXXXI—A Portable Cottage for the Use of Emigrants and Others," *An Encyclopaedia of Cottage, Farm, and Villa Architecture and Furniture* (London: Longman, Orme, Brown, Green, Longmans, 1839), pp. 251–57.

96 Herbert, "The Portable Colonial Cottage," p. 265; "Prefabs for the Prairies," [reprint of Illustrated Catalogue, Description and Price List of Clemens' Ready Made Sectional Houses, 1872"] *JSAH* XI (March 1952), p. 30; Charles Peterson, "Prefabs in the California Gold Rush, 1849," *JSAH* vol. XXIV (Dec. 1965), p. 321.

97 Melanie Louise Simo, *Loudon and the Landscape, from Country Seat to Metropolis* (New Haven: Yale University Press, 1988), pp. 129–30.

98 Loudon, *An Encyclopaedia of Cottage, Farm, and Villa Architecture and Furniture*, p. 257.

Given the Dutch station's ability to respond to opportunities as they presented themselves, the question arose "why should France not have something comparable?"[99] Lacaze-Duthiers answered that the Dutch station called for displacements which were too rapid and jarring. His original plan envisioned the station as a point of departure and return for a scientific caravan, not the portability of the station itself. In any case, he argued that none of the areas visited by the Dutch laboratory possessed the inexhaustible natural interest of Roscoff. One only had to flip through the pages of the *Archives*, Fredericq noted, to appreciate the region's long-term viability as a site of research. But what Lacaze-Duthiers judged to be the truly invaluable advantage of Roscoff was that it offered lodging to its researchers.[100] While the Dutch station was an ingenious solution to the mobility, the naturalist still needed to find lodging wherever the laboratory was stationed. This need might very well have limited the range of the laboratory's mobility to inhabited places, as opposed to the open-ended research of the scientific caravan. But the laboratory did have one resident whose function can be seen as central to the notion of lodging itself, or how the research station became a habitation.

Becoming sedentary inevitably meant taking possession of place; the job of ensuring the station's state of affairs if not its real estate fell to the resident commissioner. Curiously, the published image of the station shows a low fence surrounding it, put there to keep out idle onlookers. But it also marks off the laboratory's domain, even if it is temporary. Returning to the image's caption, "the station such as it appeared at . . . ," it is well to note that the emergence a place-name was coeval with the conception of private

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99 Adrien Dollfus, "La station zoologique de la société Néerlandaise de zoologie," p. 19.

100 Léon Fredericq's analysis appeared in Lacaze-Duthiers, "Laboratoire de zoologie expérimental de Roscoff, Compte Rendu des améliorations et des Travaux de 1874–1878,"

property. The actual duties of the resident commissioner revealed in practice what was required to reside, even if temporarily, in fixed location. While any one of the buildings in the background of the image could just as well be the hotel where naturalists actually lodged, the resident commissioner squatted on the station's "possessions." Responsible for "running the business" of the laboratory, he was required to remain "on the job" (*an Ort und Stelle* in the original German of the report). He managed the laboratory's "reserves" and ensured that everything the researchers required was in place.

We can begin to discern what is at stake in this deceptively simple statement when we look at the distinction which would later be made by Martin Heidegger between a location (*Ort*) and a given site (*Stelle*). Only something that is itself a location can make space for a site. To rephrase his noted example of a bridge, before the laboratory stands, there are many sites where it may be put. One of them proves a location, and does so because of the laboratory. The laboratory does not come to stand in a location; rather, a location comes into existence by virtue of it. For Heidegger, as Francesco Dal Co has discussed, the home arises as that which makes the *Ort* issue from the *Stelle*.[101] Taking possession of things (of time and place) is the gesture through which a separateness, the interior of the home emerges. The act of dwelling allows man to hold on to his chosen place by laying things aside and providing for his future wants. The significance given to the act of dwelling arose in this discourse not in spite of the uprootedness of the home but because of it. The house arranges things so that there could be relation to place when the preexisting relationship is cut or where it never existed. For our purpose, the resident commissioner can

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AZEG t. VI (1877), p. 317. Fredericq would reprint his appreciation of Roscoff verbatum in *La lutte pour L'Existence* (Paris: J. B. Ballière, 1889).

101 Dal Co, *Figures of Architecture and Thought*, p. 38.

be thought of in less philosophically charged terms as a lieutenant: he occupies a post by literally handling place. His role was intrinsic to the emergence of the fixed habitation.

Not surprisingly, the Netherlandish Zoological Society eventually made plans for a stationary laboratory.[102] In contrast to the simple wood construction of the "flying" laboratory, the Society built a "stylish" stone structure near Helder, situated in a small park.[103] One American visitor called it the very model of all the conveniences and comfort a naturalist could hope for.[104] It also took on the trappings of an institution, becoming the home for the Society's extensive library and a museum. Eventually the portable station was parked next to it, serving as a supplemental aquarium. Lacaze-Duthiers analysis of the flying station can be read as a statement of his own abandonment of any idea that his station would be a portable or temporary affair. At about the time of its publication he wrote a note to the Minister of Education which discussed the possibility of obtaining a house and a garden for use as the laboratory.[105] Only with its outright purchase, he argued, would the station be free from the threat of being "displaced" from the currently rented quarters. Reflecting on the growing number of researchers who came to Roscoff, Lacaze-Duthiers later wrote that he had to abandon any thought of displacement and to propose instead to "finish" the establishment.[106] As he wrote to the minister, however, his

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102 René Sand, "Les laboratoires de zoologie," *Revue de l'Université de Bruxelles*, t. III (October 1897), p. 33.

103 Ibid., p. 33.

104 Bashford Dean, "Notes on Marine Laboratories of Europe," *The American Naturalist* vol. XXVII (July 1893), p. 637.

105 Lacaze-Duthiers letter to Minister of Public Instruction (n.d.) Archives of the Station Biologique de Roscoff.

106 Lacaze-Duthiers, *Enquêtes et Documents Relatifs à l'Enseignement Supérieur XIII, Laboratoire Maritimes*, p. 5.

request was made only after the period in temporary quarters made him certain of the station's future success.

Chapter IV

THE FOYER OF SCIENCE

> Son siège était partout, partout où se trouvait un homme capable de faire œuvre de maître, au Muséum, au Collège de France, à l'École normale, à la Faculté des sciences, à la Faculté de médecine, sorte de colonie des sciences, distribué, sans points d'attache immuables, sur tout le Quartier latin, de la Bièvre au Luxembourg—Louis Liard, *L'Enseignement Supérieur en France, 1789–1893* [1]

The notion of the foyer of science serves here as a theoretical preface to the historical question of the halting emergence of the laboratory in nineteenth-century France. As a trope, the foyer appeared at various junctures in the discussion of how French science was to be housed, and how the rooms of that house were to be distributed. The foyer, of course, carries with it profound associations of shelter. From the core sense of gathering around a

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[1] Louis Liard, *L'Enseignement Supérieur en France, 1789–1893* (Paris: Armand Colin, 1894), II, p. 295.

fire, the term has evolved to mean a place of social or professional gathering. Yet the connotation of fire and the acts required to maintain it are equally germane to our understanding of the laboratory. The very act of maintenance will provide an insight into how the laboratory situated forms of work without itself first having a definite form. I argue in this regard that directors of laboratories were analogous to the guards discussed in the previous chapter, namely those who remained on the premises and made it ready for research and pedagogy. If they did not literally stoke the fire, their presence animated the settings in which science was to take place.

Our historical question revolves around the research consortium established in 1868 as the École Pratique des Hautes Études, and how it solved the spatial if not architectural problem of creating new teaching and research laboratories.[2] The passage cited at this chapter's opening limns the remarkable features of the École, which in fact occupied no single edifice. The notion that "its seat is everywhere" reveals that it was not bound by walls in any conventional sense. Indeed, the claim to universality contrasts with what we have seen as the particularism of our naturalists' desire to transport the seat of their observation. This chapter will examine how the specific colonies of science which comprised the École were not constructed but rather "distributed," as Liard described it. Its approach to creating laboratories was architectural not in the sense of designing space, but in devising a strategy for deploying space. Its plan of action was not a drawing but rather statistical and budgetary tabulations of available resources. These measures at once demonstrated the need for and proved the viability of such an "elastic" institution the École was destined to become.

[2] On the evolution of the École Pratique des Hautes Études see Harry Paul, *From Knowledge to Power* (Cambridge: Cambridge University Press, 1985), pp. 44–59.

The result was an institution without walls—it was mobile, dispersed, irregular in form, and non-canonical. The modernity of the École arguably rested in the fact that its very identity as an institution was a bureaucratic construct. However, a pressing historic reality intervenes in this discussion, namely, the awareness on the part of French scientists and officials of the richly endowed and classically inspired palaces of science across the Rhine. Indeed, France's demoralizing defeat of 1871 led to a comparative assessment of its own scientific estate. It revealed evidence of the sort of makeshift arrangements to which naturalists in the field had become accustomed, even within the confines of Paris's great academic centers. A urgent need was expressed for suitable facilities of research. But were these facilities to be found solely in Paris? The discussion here of the intellectual topography of France allows us to mediate the model of the foyer as a center of action and the École as an entity which was in some sense distributed. Thus in coming to an understanding of how marine laboratories in particular reflected these national developments, it will be more productive to speak in these terms rather than recoursing to the conventional opposition of center and periphery. To begin, let us return to the notion of the foyer as a particular mode of occupying place.

MAINTAINING THE FOYER

The very words *douceur du foyer*, as Hans Robert Jauss discusses, associated in an untranslatable fashion a social ideal and the poetry of everyday life: the joy to be found in repose at the end of the day amid family.[3] In the writings of Hugo and Baudelaire, he shows, models of interaction in the private realm were valorized as the normative values of bourgeois life. The foyer referred not only to the notion of warmth and security, but also to

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[3] Hans Robert Jauss, *Aesthetic Experience and Literary Hermeutics*, p. 266..

the economic role of the family as a unit of organized consumption as well a hierarchical integration. Considered as a foyer, the family supposed the constant collaboration of all in this task.[4] The personal recollections of a visitor to Alfred Giard's research station at Wimereux confirm some of these impressions: *"cette vie de famille, cette vie toute de précieux enseignements dont ceux qui partent emportent un souvenir impérissable avec la promesse intérieure de revenir"* (italics in original).[5] The pleasing domestic aspect of Wimereux's design no doubt added to the creation of such fond associations.

Yet where in the lyric tradition the foyer represented the comfort to be found at the end of a day's work, the laboratory was a place of work. Indeed, in creating foyers of research, French scientists and administrators defined a way of life. What originally connected the foyer and the laboratory was the very element of fire. As Claire Salomon-Bayet writes, in the rural world of the Ancien Régime, "fire" designated a specific place of habitation and a complex family structure connected by social, economic, and affective functions. For its part, the laboratory was originally understood as the fire a chemist used to experiment on specific materials; its meaning was not yet severed from associations with the subterranean furnaces at the center of the earth itself. As a place of experiment, the laboratory was where things came to pass. In Bayet's words, the fire signified the sole fixed and constant point in the cycle of observation which supposed ongoing investment and maintenance. The foyer was the place of lodging, real or nominal, for those who tended the fire, and by extension who arranged the material circumstances of observation and

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[4] J. Stoetzel, quoted in Hans Robert Jauss, *Aesthetic Experience and Literary Hermeutics*, p. 340, n. 43; see also Monique Eleb-Vidal, Anne Debarre-Blanchard, "Architecture domestique et mentalités, Les Traités et les Pratiques XVIème-XIXème Siècle," *In Extenso* no. 2 (1984), pp. 151–52.

[5] Quoted in Alfred Giard, "La station zoologique de Wimereux de 1874 a 1899," in Alfred Giard, *Oeuvres Diverses*, II, p. 82.

experiment. It was organized in relation to a set of external and internal circumstances. The materials and manpower necessary for its maintenance needed to be dependably available in the vicinity; these same quantities needed to be sensibly consumed within the household/laboratory to ensure an efficacious result.[6]

There is something at stake philosophically in the notion of maintenance and its relation to the laboratory as an architectural type. Given its distribution in disparate institutions of pedagogy and research, the unity of the École was "maintained," in Duruy's words, by the budget which constituted it. The notion of maintenance, as Jacques Derrida writes, allows us to consider a building less as a thing than as a happening. It stands opposed to the idea of monuments endowed with prior well-defined meaning.[7] "Maintenant" also means "maintaining" or persisting in space and time, literally being held-in-hand there. As Edward Casey explains, "in the case of architecture, an event is not only something that takes place (*a lieu*); it also *gives place* (*donne lieu*), gives room for things to happen."[8] The maintenance of the scientific foyer results in experimental outcomes which are not reducible to the place of experiment. It represents a mode of action and, by implication, the place in which it unfolds. The budget, as will be shown, represents as much a script as a plan for when and how those events will take place. Having arrived at this set of theoretical conclusions, we now turn to the historic question of the École's creation.

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[6] Claire Salomon-Bayet, *l'Institution de la science et l'experience du vivant* (Paris: Flammarion, 1978), pp. 378–79.

[7] Edward Casey, *The Fate of Place* (Berkeley: University of California Press, 1997), p. 312. Derrida's discussion of "maintenance" can be found in "Pointe de Folie—Maintenant l'Architecture," trans. Kate Linker, *AA Files* no. 12 (1986), sec. 3.

[8] Casey, *The Fate of Place*, p. 312.

Chapter IV

BUDGET AND STATISTICS

Appointed minister of public education in 1863, the liberal historian Victor Duruy envisioned a number of important reforms, among them redirecting secondary education from classical languages and philosophy toward practical preparation for the increasingly industrialized society of Second Empire France. Having early on sought to establish chairs in political economy in industrial and agricultural centers, believing they would contribute to the proper "management" of France's wealth, Duruy himself became a prudent and in some sense adventurous manager of his ministry's scattered resources.[9]

The series *Rapports sur les Progrès des Lettres et des Sciences* that Duruy commissioned in conjunction with the Universal Exposition of 1867 encapsulated the advanced state of the various branches of French research and scholarship. Milne-Edwards, who wrote the report on zoology, recorded the important conceptual and factual advances stemming from his initial voyages to the coast and subsequently pursued by Quatrefages and Lacaze-Duthiers. A new age of discovery was just beginning with the deep-sea expeditions led by his son, Alphonse Milne-Edwards. But even if Milne-Edwards's report was in itself an impressive feat of scholarship in a field which was becoming increasingly specialized, all was not well with French science. In his report on general physiology, Claude Bernard warned that unless researchers were provided with the proper "means of work," their professional and intellectual "evolution" would be arrested with dire consequences for the state.[10] He felt it necessary to explain that apparent lapses in the record of his own work

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[9] See Sandra Hovrath-Peterson, *Victor Duruy & French Education, Liberal Reform in the Second Empire* (Baton Rouge: Louisiana State University Press, 1984), p. 188; Weisz, *The Emergence of Modern Universities in France, 1863–1914* (Princeton: Princeton University Press, 1983), pp. 60–61.

[10] Claude Bernard, *Rapport sur les Progrès de la physiologie Générale en France* (Paris: Imprimerie Impériale, 1867), p. 148.

were not due to a lack of time nor the difficulty of executing particular experiments, but a lack of "material means" with which to carry them out.[11] In his writings of this period, Bernard joined a chorus of researchers, administrators, and journalists who deplored the conditions of the France's research establishment, or what passed for it on a presumably temporary basis. According to Bernard, the greatest challenge facing France's intellectual elite was not of the conceptual order. Rather, it was finding suitable places to carry out their research.

Before he undertook any reform to "our scholarly houses," in 1865 Duruy commissioned a vast inquiry, the *Statistique de l'Enseignement*. In the tradition of the regional tableau, the document took minute account of the actual status of teaching and research establishments—their location, their subventions, enrollment, degrees granted, and other pertinent statistics. In these volumes, he claimed, were to be found all the facts and figures necessary to establish the situation of the academic edifice.[12] Duruy regarded the topography mapped out by the *Statistique* as a checkerboard on which to enact his plan of action.[13] What the *Statistique* revealed, in the words of Liard, the future director of higher education, was that things as they stood were "impoverished."[14] The departmental faculties were bleak. Examples could be found of research taking place in ill-equipped rooms in a city hall, an old convent, and in a "labyrinth" of connected townhouses. Researchers did not occupy locations which were suitable to them, but rather whatever

[11] Ibid., p. 148, p. 236, no. 237.

[12] Victor Duruy, *Notes et Souvenirs (1811–1894)* (Paris: Librairie Hachette, 1901), I, p. 301.

[13] Ibid., p. 301.

[14] Louis Liard, *L'Enseignement Supérieur en France, 1789–1893* , II, p. 272.

location first became available. Liard wrote of a purgatory in which they were forced to await "the end of a temporary situation which was without end."[15]

If the lack of proper facilities in the provinces was not entirely surprising, nowhere was the bane felt more keenly than in Paris. After August 13, 1855, when the cornerstone was placed for the new science faculty at the Sorbonne—at the ceremony Haussmann spoke with pride of Paris as the indisputable center of the sciences and letters—no further construction took place for thirty years.[16] The *Statistique* made clear the serious shortage of space and material means which developed during this delay. The section on the Muséum d'histoire naturelle, for example, found "the lack of space absolutely opposed to the methodical arrangement of objects." Not only were specimens from natural groups separated, but the warren of rooms was deficient from the "double point of view of surveillance and study."[17] The Muséum, once thought by Cuvier to be a respite from the agitation and uncertainties of field work, had itself become a disorderly place where neither specimens nor researchers could were properly accommodated.

"LE BUDGET DE LA SCIENCE"

If the *Statistique* represented a comprehensive ministerial effort, prominent individuals such as Louis Pasteur drew on their personal prestige to address in passionate terms the plight of French science. Pasteur's *Le Budget de la Science* (1868) argued that "the time has come to free the experimental sciences from the poverty which shackles them."

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[15] Ibid., p. 271.

[16] Jean Bonnerot, *La Sorbonne, sa Vie, son Role, son Oeuvre a Travers les Siecles* (Paris: Les Presses Universitaires de France, p. 1935), p. 35; Louis Liard, *L'Université de Paris* (Paris: Librairie Renouard, 1909), p. 77.

[17] Ministère de l'Instruction Publique, *Statistique de l'Enseignement Supérieur (1865–68)* (Paris: Imprimerie Impériale, 1868), p. 608.

Originally intended for the official *Moniteur Universel*, the statement was censored by the minister of state, who found it compromising to the administration. However, the page proofs were shown to Napoleon III, who was sympathetic to Pasteur's cause, and the text was subsequently published both in the reformist *Revue des Cours scientifiques* and separately as a brochure. According to Pasteur, *Le Budget* was written to help him "negotiate" with the Minister for "light, air, and space."[18] As its title indicated, it was from the tangled budgets of the isolated but interconnected faculties that these elements, basic for all researchers, had to be wrested.

Pasteur related the following anecdote: two members of the Academy of Sciences were discussing one of France's pre-eminent chemists, who was confined to his bed due to a respiratory ailment. "What do you expect, responded one of them, laboratories are the tombs of savants."[19] The speaker of the retort was none other than Bernard. Where was this unsanitary, humid, dark, and poorly ventilated laboratory? At the institution bearing the very name of the *patrie*: the *Collège de France*. In these conditions, Pasteur noted wryly, the physiologist could not even be certain whether his subjects died due to experiment or the detestable spaces in which they were kept. *Le Budget* argued that laboratories and not lecture halls were the proper "abode" of the research scientist. In addition, the laboratories would have to be properly equipped and could not pose a heath risk to the savants who worked in them.

The very term "laboratory" appealed to Pasteur, who considered it a "sacred abode" in which the scientist learned to read from the book of nature and improve the

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[18] *Œuvres de Pasteur* (Paris: Masson et Cie., 1939), VII p. 204, n. 1. See Patrice Debré, *Louis Pasteur* (Paris: Flammarion, 1994), pp. 161–67.

[19] Louis Pasteur, "Quelques Réflexions sur la Science en France," *Œuvres de Pasteur*, VII, p. 200; it was originally published as "Le Budget de la Science," *Revue des Cours Scientifiques* (February 1, 1868).

condition of mankind. In the absence of such laboratories, he argued to the minister, the life of science was impossible. Throughout the nineteenth century, enterprising scientists made direct appeals to the state or to industry to favor their research.[20] Pasteur himself mentioned the example of Jean-Baptiste Dumas and Jean-Batiste Boussingault who operated laboratories entirely at their own expense. Curiously, Pasteur couches his discussion in terms of the domestic economy of the laboratory itself. The proper management of its material resources was imperative for the production of knowledge. The foyer, according to Pasteur, was "image of life and fecundity."

As Pasteur described it, the household of French science was not in order. One prominent chemist worked for ten years without a laboratory assistant; as soon as he was done with an instrument, he turned around and cleaned up after himself. "Imagine the material time which he was forced to lose in these domestic occupations, time which could have been used for the profit of everyone, perhaps in enriching science and industry with new discoveries."[21] The failure of the scientific budget to provide for an assistant meant that an effective division of labor could not be realized. Similar statements by Bernard made clear that "domesticity" was not something which encroached on scientific work, but rather was integral to the organization of the research task. Presenting to his a class a drawing of Ludwig's laboratory in Leipzig from the chemist Adolph Wurtz's report on the German institutes, Bernard spoke:

> Il est très-important pour une bonne économie expérimentale d'avoir des pièces séparées pour les expériences qui réclament une instrumentation spéciale. On évite

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[20] Robert Fox, "Scientific Enterprise and Patronage of Research in France 1800–70," *Minerva* vol. XI, n. 4 (October 1973), pp. 442–473.

[21] Pasteur, "Quelques Réflexions sur la Science en France," p. 204.

> ainsi toutes les pertes de temps qu'exigerait une nouvelle installation et la réunion de matériaux quelquefois très-difficile à rassembler.[22]

For Bernard, the arrangement of the household was essential to the effective "administration" of the researcher's time.[23] Working out a budget meant making place for a proper experimental economy and ensuring that different types of labor were carried out by appropriate staff so that nothing was wasted. As Wurtz indicated, in its architecture and decoration Leipzig had an air of simplicity which did not exclude "good taste." The building was without the grandeur and luxury of those at Berlin and Bonn, but though its plan lacked harmony, it was perfectly disposed to the needs of scientific work, teaching, and domestic life.[24]

Several weeks after the publication of *Le Budget*, on March 16, 1868, Napoleon III convened a meeting at the Tuileries palace with Pasteur, Bernard, Sainte-Claire Deville, Henri Milne-Edwards, Duruy and a number of influential advisors to discuss what was to be done about the French research establishment. Their responses addressed not only issues such as the professional advancement of researchers but also raised specific question as what was to be regarded as a foyer, how it was to be managed, and where it was to be located. It was in part the administration's inability to reconcile instruction with research which resulted in the professors being forced to carry out independent studies during their own time, or what remained of it after preparing their courses. In Bernard's case, space was never found at the Sorbonne for his laboratory; his chair was ultimately transferred to the

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[22] Claude Bernard, *Leçons sur les Phénomènes de la Vie, Communs aux Animaux et aux Végétaux*, p. 14.

[23] Claude Bernard, *An Introduction to the Study of Experimental Medicine* (New York: Dover, 1957 [1865]), p. 15

[24] Adolphe Wurtz, *Les Études Pratiques dans les Universités Allemandes, rapport présenté à son Excellence M. le Ministre de l'Instruction Publique* (Paris: Imprimerie Impériale, 1870), p. 51.

Muséum d'histoire naturelle, where Bernard took over the laboratory which had formerly been a stable.[25] But the Muséum could not accommodate a range of new laboratories any more than the Collège de France or the Sorbonne could. Thus the recommendations Bernard and Pasteur wrote following the meeting returned again to the question of where space was to be found for research.

The two principal concerns confronting science, Bernard wrote to the minister, were instruction and the advancement of knowledge itself. If primary and secondary education produced the "underlying foundation," higher education served as the "luminous foyer which illuminates and fertilizes all the rest." The problem with higher education, though, was that in preparing students for examinations, the curriculum was based solely on "completed science," namely what was already known and demonstrated. He argued that the student needed to be allowed to "walk by himself along the paths of scientific investigation." This approach meant abandoning fixed programs and allowing the student's creativity to lead the way within carefully monitored limits. The professor was to allow the student to go as far as his own resource would take him, but step in to correct him when he truly lost the way. Bernard sought a balance of supervision and liberty, rules and innovation, which would allow the student to arrive at new insight through experiment based on a solid foundation in fact. He suggested that instruction itself should be bifurcated into required courses offered by professors who were gifted with speaking and elective experimental courses given by professors with a gift for invention.

Bernard made a number of recommendations on the siting and geographic distribution of laboratories. The major obstacle to the creation of foyers which would stimulate the interest of students through the example of the professor/researcher was the

[25] Archives Nationales, series F [17] carton 13566.

centralization of the academic system. Not only were provincial faculties remote from Paris, but they were isolated from one another. A given academic faculty might have a chair in physics but not zoology, meaning the professor had no colleagues. The solution was to create a number of university centers which would unite different faculties into a "compact and conjoined scientific corps." Where these centers were to be located depended on the nature of the region:

> Telle partie des sciences naturelles par exemple pourrait être à proximité de la mer ou dans certaines localités particulières cultivée plus fructueusement qu'à Paris; et si là un professeur trouvait un centre scientifique important il pourrait attirer par sa célébrité les élèves des autres centres universitaires qui désireraient se perfectionner dans cette branche spéciale de la science.[26]

While these centers would remain dependent on the universities, Bernard advocated that they should establish ties to the cities which would be their "seat." This would be a way for the local administration and representatives of industry to take an interest in the university, and to keep scientifically prominent people in regional centers.

Bernard's comments concerning the distribution of faculties according to the specific settings they required (be they natural or industrial), in addition to the presence of a concentration of expertise, touch on the reasoning employed by the Saint Simonian Jean Reynaud in his discussion of the emergence of cities. In order to understand the "influence of geographic inequalities" on the respective fortunes of diverse city centers, he postulated two regions which, due to either the richness of their soil or the state of their civilization, were not equally fecund. This inequality would result not only in a different overall number

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[26] Claude Bernard, "A S. E. Monsieur le Ministre de l'Instruction Publique," in Ashley Miles, "Reports by Louis Pasteur and Claude Bernard on the Organization of Scientific Teaching and Research," *Notes and Records of the Royal Society of London* vol. 37 (1982–83), p. 106.

of houses in the respective regions, but different patterns of their distribution and even the degree of comfort to be found in them. Adding to this equation climate and the availability of natural resources, Reynaud induced a "law" for "calculating" where "singular points" would emerge and for identifying the factors which sustained their development.[27] To be sure, Bernard's notion of a university center by the sea was nothing more than a passing insight. But it had the effect of opening up the question of how the resources necessary to the development of centers of research were to be identified and husbanded.

Pasteur's response to the minister, which addressed the maintenance of the researcher's domestic foyer, proposes a complimentary understanding of the use and distribution of resources. To begin with, he dismantled the impression that there were more qualified science students in German universities than in France. The misperception resulted from the fact that the brightest French students were concentrated in the prestigious state school centralized in Paris, which led directly into employment as high-level civil servants or as the captains of industry.[28] Pasteur argued that if one "distributed" these students over the extent of France, their number would equal those of the regional German institutes. In this exercise Pasteur demonstrated graphically the problems which confronted the establishment of the kind of centers Bernard envisioned. As it stood, the provincial faculties served as feeders for the so-called *grandes écoles*, which in turn "spread the fertile seed" of learning. But Pasteur was quick to note that the *grandes écoles* themselves faced considerable problems. He noted the waning prestige of the two "nurseries" of French scientific greatness: the Muséum d'histoire naturelle and the École Polytechnique. In the case

[27] Léonce Reynaud, "Villes," *Encyclopédie Nouvelle, Dictionnaire Philosophique, Scientifique, Littéraire, et Industriel* (Paris: Librairie de Charles Gosselin, 1842), VIII, p. 674.

[28] These institutions included: l'École Polytechnique, l'École Normale, l'École des Mines, l'École des Ponts et Chaussées, l'École Centrale des Arts et Manufactures.

of the Muséum, Pasteur mentioned the diminished activity of the Muséum's traveling naturalists. He wrote with regard to the question of evolution: "Is in within the perimeter of Paris that one can try to resolve it. It is not in the virgin forests of America where they must take their work of observation?"[29] The juxtaposition of virgin forests to the various means by which the attenuated seed of French science was being cultivated is striking.

Pasteur's discussion of the foyer was embedded in a critique of the *cumul,* the practice whereby professors held multiple teaching positions simultaneously to increase their income. It also juxtaposed the demands of the domestic and scientific foyers. The typical professor, he explained, begins to achieve success at the very same period of his life when the "material needs of his family multiply." To meet these needs, he adds a second and third position, thereby augmenting his income but diminishing greatly his time for leisure. Leisure time, however, was not to be devoted to the domestic foyer, but to the pursuit of pure research. By contrast, he lauds the German system where universities bid for the honor of having a well-known professor on their faculty. "Master of the conditions of his career," the professor was lured to a university by the promise of elaborate laboratory space.

The German institutes were not magnificent for their architecture, he notes, but in the number and precision of the instruments and in the availability of funding for large-scale research projects. Indicating another essential feature of their success, he noted that the professors,

> ont leur demeure jointe à leur laboratoires ou à leur collections. Il ne faut pas que l'on puisse se représenter Cuvier éloigné de son cabinet et des richesses du museum, les

[29] Louis Liard, *l'Université de Paris*, p. 79.

de Jussieus habitant loin de leurs herbiers, Arago quittant une demeure placée de l'autre côté de la Seine pour se rendre au cabinet de physique de l'observatoire.[30]

In his book on the Jardin des Plantes, Jules Janin described a walk down the rue Cuvier, looking into all the windows he passed; just as those visiting the cabinets would see the different families of animals, he identified the families of Saint-Hilaire, Jussieu, and Brongniart, who were not only the producers of French science, but the denizens of the housing which boarded the collections and menagerie of the museum. The names Janin evoked were of families that passed the vocation down through the generations; to enter science now, Pasteur wrote, meant either having a private fortune or an indomitable will. The problem resided in the very monopolization of paid positions. The remedy was to get rid of the system of the *cumul,* a system to which the scientist is constrained by the need to "bring ease to his domestic foyer!"

THE GERMAN THREAT

Pasteur's discussion of the German research establishment resonated deeply with the sentiment, held by scientists, politicians, and journalists, that by comparison French science was in a period of decline.[31] Scientists such as Georges Pouchet criticized the French system of chairs in established disciplines, which did not respond to developments in science itself. In the German system, by contrast, professorships were created or suspended according to the prestige of the branch of knowledge they represented, a sort of free-market structure

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[30] Louis Pasteur, "Opinions Présentées par M. Pasteur, dans la Réunion du 16 Mars 1868 au Palais des Tuileries," "Reports by Louis Pasteur and Claude Bernard on the Organization of Scientific Teaching and Research," p. 109.

[31] See Harry Paul, "The Issue of Decline in Nineteenth-Century French Science," *French Historical Studies* 7 (1972), pp. 416–450.

applied to the professoriat.[32] Of more direct importance to this discussion is the French perception of the German research institutions. Having made a reconnaissance tour of the German states, Pouchet wrote of the new laboratory of Berlin as:

> un bâtiment de proportions grandioses et élégantes, sans fulités, sans ornemens déplacés ou prétentieux; si les peintures archaïques des couloirs rappellent encore le vieil esprit allemand, la disposition générale de l'édifice est conçue d'après les vues les plus récentes de la science.[33]

The most famed structure was the Institute of Heidelberg, Ludwig von Helmholtz's so-called Nature Palace. The government of Baden lured Helmholtz away from Bonn, when the government of that city did not offer enough to entice him to stay in Prussia. Like a shore teeming with specimens, his laboratory was "rich in instruments," for which the government made "heavy sacrifices."[34] Such institutes served as enticements by municipalities wishing to gain eminent professors for their faculties. Architectural edifices replaced the geographic advantages which Bernard believed would be the cause for the creation of centers of research.

How different from the situation described by Fernand Papillon in "Les Laboratoires en France et à l'Étranger" (1871). The article criticized the "cabin" at the Muséum d'histoire naturelle in which Pierre Flourens was forced to worked, among other such abuses.[35] By contrast, Pouchet asked his readers to share the emotion of the student who crosses the

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[32] See Lynn Nyhart, *Biology Takes Form, Animal Morphology and the German University* (Chicago: Chicago University Press, 1995), pp. 12–20.

[33] George Pouchet, "L'Enseignement Supérieur des Sciences en Allemagne," *Revue des Deux Mondes* XXXIX année, t. 83 (1869), p. 448.

[34] Wurtz, *Les Études Pratiques dans les Universités Allemandes*, p. 61.

[35] Fernand Papillon, "Les Laboratoires en France et à l'Étranger," *Revue des Deux Mondes* XLI année, t. 94 (1871), p. 602.

threshold of one of the great German universities for the first time. In Germany the initiation into learning was verily an architectural experience. These buildings were without extravagance, lest the student lose his way before reaching his goal. But in Berlin, the science faculty was situated opposite the emperor's palace. The civic realm served as the very corridor between the halls of power and those of learning.[36]

The situation of the German institutes itself became to the object of scientific inquiry on the part of the French. In the months after the meeting at the Tuileries palace, Duruy commissioned Wurtz to visit cities which had laboratories, scientific collections, and clinics. Wurtz wrote that his goal was to identify those which could serve as "models" for the architects who would be charged with the plans for the new Sorbonne and the École de Médicine, where he was a professor.[37] Wurtz's own laboratory at the École de Médicine also suffered from the penury of French science. Irregular in its arrangement, this "narrow dispensary" which could barely accommodate ten people was considered among "the most important foyers of research."[38] Wurtz's *Les Études Pratiques dans les Universités Allemandes* (1870) was remarkable for its detailed plans and illustrations. His report included observations and criticism ranging from the siting and facade of institutions to the layout of worktables and plumbing. Wurtz was not content with discussing how the universities managed to reconcile the demands of teaching and research, but narrated visits through the buildings, allowing his readers, the minister among them, to experience the connected ceremonial, working, and domestic spaces which comprised the institutes. Drawing from these observations, Wurtz insisted on the necessity in France to "annex" to each chair a

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[36] George Pouchet, "L'Enseignement Supérieur des Sciences en Allemagne," p. 430.

[37] Wurtz letter to Ministre of Public Instruction (Paris, May 12,1868), Archives Nationales, series F^{17} carton 3014 B.

[38] Papillon, "Les Laboratoires en France et à l'Étranger," p. 601.

laboratory as just one of the "material resources" necessary for the advancement of science.[39]

During his opening lecture at the Muséum, Bernard showed his students the plan of Ludwig's laboratory from Wurtz's report as an example, in Papillon's words, of an "ideal laboratory."[40] Satisfying Bernard's recommendation that university centers establish ties with their urban hosts, Wurtz indicated that Leipzig was both a "scientific foyer" and a "commercial metropolis." On a smaller scale, the university presented, in an enviable fashion, all of the features and interconnected services of a well-managed small city. It even included a small scale "railroad" on which a professor's demonstration table and all his experimental apparatuses could be transported between different wings of the institute.[41]

> Ce n'est pas tout; le professeur, le chef de ce grand établissment, qui y enseigne en public, qui inspire, ordonne, surveille tous les travaux pratiques des élèves, y poursuit aussi ses recherches personnelles. Il y passe ses journées, il y revient quelquefois le soir pour suivre une expérience commencée. Cela est facile; il a non-seulement son laboratoire particulier, son cabinet, il a aussi son appartement dans l'établissement même. Et il en est ainsi pour un ou plusiers préparateurs et surtout pour ce serviteur dont les fonctions humbles, mais si importantes, ont pour objet le maintien de l'ordre et de la propreté: j'ai nommé le garçon de laboratoire. Quel avantage que la présence à demeure du professeur et de ses aides sur les lieux mêmes où s'exerce leur activité! Quelle facilité pour l'exécution des opérations de longue durée, pour la vérification expérimentale d'une inspiration subite! Quelle économie

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[39] Adolphe Wurtz, *Les Études Pratiques dans les Universités Allemandes*, p. 5.

[40] Papillon, "Les Laboratoires en France et à l'Étranger," p. 599.

[41] Ibid., p 606.

> de temps, quel stimulant pour ceux auxquells l'éloignement serait un exil, pour ceux encore auxquels la fatigue ou l'âge serait une excuse; pour tout dire, quel gain pour la science![42]

Living and working spaces, places for instruction and research each and all were arranged with the economy of time which was the program for the effective use of the researcher's labor. Evidently, it was also what was needed to make the university center an attractive place for the researcher and his students. In this milieu, Wurtz wrote, the inspiration for scientific work reigns, as does the flourishing of artistic creativity in centers of art.[43] The tone of Wurtz's report, however, was as likely to inspire the clearing of a marshaling ground as the erection of a scientific Parnassus. An "army" of laborers was at work in German universities, he wrote. Even the "simple soldiers" who were not engaged in pure research were devoted to the advance of industry.[44] Thus when Duruy sought to redress the problems of French science and industry, the laboratories which for Pasteur represented the sanctum of the researcher became "arsenals of science."[45]

ÉCOLE PRATIQUE DES HAUTES ÉTUDES

By his own admission, Duruy was not interested in questions of art or of taste, to the extent that they had been raised in Wurtz's report on German universities. And though marveling that all of Paris was being made anew by Haussmann, he was not concerned that

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[42] Adolphe Wurtz, *Les Études Pratiques dans les Universités Allemandes*, p. 11.

[43] Ibid., p.11.

[44] Ibid., p. 82.

[45] Victor Duruy, "Rapport de S. Exc. M. le Ministre à S. M. l'Empereur, précédant les deux décrets du 31 juillet 1868, relatifs aux laboratoires d'enseignement et de recerches et à la création d'une école pratique des hautes études," *L'Administration de l'Instruction Publique de 1863 à 1869* (Paris: Jules Delalain, [1870]), p. 644.

the construction of schools keep stride with the advanced architecture of Paris's department stores and train stations.[46] Described by Liard as an "innovative and entrepreneurial minister," Duruy saw in the shameful situation outlined in the "Budget" the opportunity for a new type of development. In his introduction to the *Statistique*, which took the form of a direct address to the emperor, Duruy employed a rhetoric instead of facts and figures to suggest what would become a key concept of his plan: "The edifice is old but solid in its foundations; all that is required are appropriations for new necessities."[47] In essence an administrative entity, the École Pratique des Hautes Études represented an attempt to make the scientific budget a highly responsive tool for allocating support to the right place at the right time. Even if large-scale capital investment was necessary to restore buildings built long ago, it could be borne through proper drafting of the budget.[48] The *Statistique*—a topography of pedagogic and research institutions, however ill-founded—would serve as a preliminary indication of how existing resources could be exploited. "One is contented with little . . . without care for elegance or even comfort."[49] The École was not to be built anew; rather room was to be found for it within existing structures.

By "École pratique," Duruy did not mean that it was to be an institution devoted to the pursuit of industrial or agricultural applications. Rather the term referred to "work with the eyes and the hands."[50] As Duruy explained, science consisted not only of a set of doctrines which could be taught in the lecture hall, but was also itself an "instrument" which

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[46] Ibid., p. 735.

[47] Ibid., p. 676.

[48] Ibid., p. 645.

[49] Ibid., p. 767.

[50] Ibid., p. 653.

needed to be "handled" with skill. With the approbation of Milne-Edwards, Bernard, and Pasteur, a decree of July 31, 1868 instituted the École by creating the rubrics for teaching and research which furnished respectively the elements of a "true scientific laboratory." Namely,

The perfect instruments and tools

The most intelligent collaborators[51]

In the teaching laboratories students learned to use instruments and to employ reason as they carried out experiments directed by the professor.[52] Liard compared the arrangement to a workshop in which there were apprentices and masters.[53] Through this form of apprenticeship, the teaching laboratories served as the "seed bed" from which the directors of the research laboratories could choose their "auxiliaries." Having received instruction not merely in established fact [*science faite*], but having been initiated into experimental practice, or science in making [*science en formation*], students were ready to collaborate with their professors in teaching laboratories. With money, Duruy indicated, the laboratories of both types would be provided with all the necessary material means. But it was only through their "good organization" that a cadre of "collaborators" would be formed in them.

Despite its impressive name, the École was not an institution in the conventional sense, but rather an "arrangement" for organizing teaching and research.[54] It was a mechanism for managing and distributing the available means to produce innovative ends. Inasmuch as it was founded, the École did not involve the construction of a single building.

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[51] *Statistique de l'Enseignement Supérieur (1865–68)*, p. 714.

[52] Ibid., p. 716.

[53] Liard, *L'Enseignement Supérieur en France, 1789–1893* , II, p. 294.

[54] Mary Jo Nye, *Science in the Provinces* (Berkeley: University of California Press, 1986), p. 16.

Its foundations were wherever capable researchers and space available for their work were located. The École Pratique, wrote Duruy, was not contained "within the walls of a single house"; rather its teaching and research functions were distributed in any number of establishments.[55] Papillon went so far as to state skeptically that the École had only a "fictional existence," meaning that scientists labored in their laboratories in same way before the creation of the École as they did after.[56]

The initial realization of the École first became apparent on the map of Paris on which Duruy indicated the premier teaching and research institutions of France, all surrounding Mont Saint-Geneviève and a short walking distance from one another: the Muséum, the Collège de France, the Sorbonne, the Observatoire, the École des Beaux Arts, and seven major libraries. In no other city, he wrote, could such a collection of institutions be found in an equally limited area; all branches of knowledge radiated from a circle, the radius of which was but several hundred meters.[57] Indeed, in 1848 Dumas had proposed a plan to improve the "paths of communication" between the various learning establishments concentrated on the left bank. His vision, beginning on the level of the sidewalk, would eventually link these establishments to one another, saving students precious moments in their transit from one to the other, and eventually connect them to the rest of Paris and from there to industry and commence.[58] The proposal, cast in terms of rationalizing the city grid, would have resulted in a continuous scientific edifice open to all members and levels of society. Duruy's plan, by contrast, sought order on another level than architecture or

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[55] Duruy, "Rapport de S. Exc. M. le Ministre à S. M. l'Empereur," p. 656.

[56] Fernand Papillon, "Les Laboratoires en France et à l'Étranger," p. 608.

[57] Victor Duruy, *Notes et Souvenirs,* p. 303–04.

[58] Jean-Baptiste Dumas letter to Préfet (1848), Archives, Académie des Sciences, Fonds Dumas, carton 18.

urbanism. The component parts of the École were not connected by sidewalks or even rail lines but by their mutual participation in a regime of "good organization." The École was above all else an effective bureaucratic entity for facilitating research while minimizing the intrusion of bureaucracy itself in the affairs of scientists.

Liard was to articulate in compelling terms the seemingly anti-architectural nature of the École's organizational structure:

> Pour les personnes qui aiment les lignes régulières et la belle ordonnance des architectures classiques, cette institution s'appuyant ainsi sur des bases disséminées et mobiles, tenant à la fois au Muséum, au Collège de France, à l'École normale à la Sorbonne, sans être ni l'un ni l'autre, pouvait paraître un porte-à-faux. Qu'importe? Malgré sa structure irrégulière et la mobilité de ses assises, l'École des Hautes Études, a été un solide édifice.[59]

The "seat" of the institution was wherever there were men capable of carrying out the functions of a researcher of teacher. The Muséum, the Collège de France, as well as provincial faculties were so many "colonies" of science without any immutable points of attachment."[60] Duruy explained the seeming paradox of an establishment which was at once solid but also mobile and disseminated, stating that it was not to be found in any special "house."[61] The role of the architect and planner were consolidated and replaced by the specialist in the scientific infrastructure. In other words, existing structures became "colonies" in which new knowledge and talent were cultivated.

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[59] Liard, *L'Enseignement supérieur en France 1789–1893*, II, p. 295.

[60] Ibid., p. 295.

[61] Victor Duruy, *Notes et Souvenirs (1811–1894)*, I, p. 302.

Yet in spite of the allure of a mobile and changeable structure of research, the first series of reports Duruy commissioned on the function of the École was not encouraging.[62] In his report for the section of zoological anatomy and physiology at the Muséum, Milne-Edwards began by commenting that it was impossible to separate the research and teaching laboratories due to an insufficiency of space. The problem was exacerbated when he was forced to cede part of his laboratory to another researcher, forcing him to reduce the number of students he could accommodate. Milne-Edwards nonetheless highlighted the productivity of his laboratory, even while indicating that it was too early to tell if the experiment was a success. The difficulties facing Duruy's plan were even more acute in the case of a science such as histology, where there were no establishments, in Charles Robin's words, available to be utilized. Robin accepted the direction of a laboratory on the belief that a permanent installation would replace "after the briefest delay the incomplete state of things."[63] Sharing space with Milne-Edwards, he could not even formulate a plan of study for his students because he could not make any demonstrations to his students which required more than an hour of preparation. He wrote that in the absence of real work space, the title "laboratory of École des Hautes Études" was a "nominal" and not actual. The result was that students who earlier had come to study in Paris from Italy and Russia were now going to Germany and Vienna with their palaces of science.

Notably, it was a series of aquaria developed on an independent basis which were put forward by some critics as the model for overcoming chronic shortages of space. The aquaria were examples of the "colonies of growth," especially as they took advantage of

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[62] Archives Nationales, series F [17] carton 13616.

[63] Charles Robin letter to minister of Public Education (March 6, 1869), Archives Nationales, series series F [17] carton 13616.

opportunities for research which lay outside of Paris.[64] The establishment which received the most attention in this regard, however, was the laboratory-vivarium established by Jean-Jaques Coste at Concarneau. By creating a "sea in miniature" in basins originally built to raise lobsters for the market in Paris, Concarneau represented in Coste's estimation a new type of observatory.[65]

> Si Marseille ou quelque port de la Méditerranée imitait cet exemple, les trois mers qui nous entourent deviendraient trois champs d'observations et d'expériences que les savants n'ont pu jusqu'à présent explorer d'une manière permanente, et où ils entrevoient les plus brillantes promesses pour la science.[66]

As Duruy points out, the most novel innovation of Concarneau was its promise of being a permanent installation. In those centers identified by Bernard where nature itself provided the materials for research, it was merely a question of capital investment to make them productive. The problem for naturalists working at the sea's edge was that there were no foundations there on which to base their efforts.

Duruy's plan for the École was projected onto a set of foundations already in place, upon which, in a space defined by scientific practice itself, room was to be made for research and pedagogy. In one sense, as made evident in the *Statistique,* such spaces were quantifiable. Facts and figures could be summoned to show how French science occupied itself. But the mobile nature of the project, its irregularity in terms of architecture, suggests the almost private nature of the individual scientist's accommodation to the particular circumstances he faced. The fact that the École had no monumental presence but was an

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[64] Victor Duruy, "Discours prononcé par S. Exc. M. le Ministre," p. 768.

[65] See Jean-Jacques Coste, *De l'Observation et de l'Experience en Physiologie* (Paris: Victor Masson, 1869).

[66] Victor Duruy, "Rapport de S. Exc. M. le Ministre à S. M. l'Empereur," p. 682.

open-ended project suggests the role of maintenance, the literal holding in place in time and space, as the "practical" element of Duruy's École Pratique. The foyer was both a place of labor and the ultimate reward for scientists who had to negotiate for air, light, and space. The pattern was set for an approach to the architecture of science which did not simply make do, but made a practice of elaborating the spaces and rooms in which research would eventually take place.

ASSOCIATION FRANÇAISE POUR L'AVANCEMENT DES SCIENCES

A distinct approach to mapping the topography of French scientific and cultural institutions and to providing material support to individuals as well as centers of research can be seen in the work of the Association Française pour l'Avancement des Sciences. Founded in 1872, the Association responded to the shame and outrage felt by naturalists and industrialists following the debacle of Sedan. In a speech which had enormous resonance with the public, Saint-Claire Deville attributed Germany's victory to the superior state of its science and industry. As president of the Association's first meeting, Quatrefages described the new order of battle in his address entitled "La Science et la Patrie,"

> [L]a grandeur des États ne se mesure pas seulement à l'étendue du territoire, au chiffre des habitants; la lutte n'a pas lieu seulement dans les champs de la guerre. De nos jours plus que jamais, le domaine de l'intelligence, le terrain de la science ont aussi leurs batailles, leurs victoires et leurs lauriers. En attendant l'avenir, c'est là qu'il faut d'abord aller chercher la revanche. Le travailleur scientifique est donc aussi un soldat.[67]

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[67] Quatrefages, "La Science et la Patrie," *Association Française pour l'Avancement des Sciences, Comptes-Rendus de la 1re Session 1872* (Paris: Au Secrétariat de l'Association, 1873), p. 38.

Quatrefages made the distinction, however, that in the military the general assumed all the glory for a triumph, while in the sciences not only was each worker honored, but each discovery added to the radiance of the patrimony.

The moment had come when the "regeneration" of France required the active leadership of its scientists, who in time of calm and political rest were at liberty to occupy themselves in their cabinet without distraction. Leaving aside the role of the individual scientist, Quatrefages was keenly aware of the role of place in the development of science and the service it offered to society. Quatrefages spoke of the need for the organization of important provincial centers which were in harmony with the needs and abilities of their surrounding country.[68] Education in these regional centers was to have a true "municipal character," its function connected as much as possible with the local industry, setting, and population of the city. Such centers of teaching and research would foster the "local spirit." He appealed to the lawmakers and industrialists of France to turn to scientists as experts of modern industrial society.

The yearly congresses of the Association offered municipalities the opportunity to participate in the advancement of the science. The mayors Le Havre, Lille, and Lyon addressed letters to the governing committee with the intention of being chosen for the next congress. The Association met for the first time in Bordeaux for eight days beginning on the fifth of September 1872, in a new building for the Société Philomatique and the concert hall of the Grand-Théâtre. The mayor of Bordeaux emphasized that commercial and industrial cities were by no means indifferent to the theoretical pursuits of scientists; rather, they were the constant beneficiaries of the improvements science brought to industry. He pointed to

[68] Henri Sainte-Claire Deville, "L'Organisation Scientifique de la France," *Revue des Cours Scientifiques de la France et de l'Étranger* no. 51–52 (November 19–26, 1870), p. 804.

the city's museum of natural history, its library, botanical garden, and finally the eminent scientists from Marseille who added glory to the "patrie" of Montaigne and Montesquieu.

The regional centers provided the great talent of France, and now the Association Française looked to them again for national regeneration. Each congress highlighted a different city's scientific, cultural, and industrial achievements, while bringing the best and the brightest to its doorstep. The printed proceedings of the congress contained not only scientific papers, but also extensive treatments of the history, geography, and resources of the region. The Association was itself a model if not a force of decentralization. Indeed, the second part of Quatrefages's speech consisted of an elaborate encomium to the hospitality of the city of Bordeaux, which had freely opened its "domestic foyers and public edifices."[69]

CREATING NEW CENTERS ON THE PERIPHERY

Following the 1879 congress of the Association Française in Montpellier, Lacaze-Duthiers made a brief tour of Roussillon which convinced him of the need to set up a winter station along the Mediterranean. In his presentation to the congress several day's earlier, he thanked the Association for providing him the funds to hire a full-time guard at Roscoff, which was critical to making the installation permanent.[70] At this point, let us turn to the negotiations by which Lacaze-Duthiers literally pieced together the foundations for Roscoff and Banyuls. The determination of where centers of zoological research would emerge depended on two equally important factors: the distribution of natural kinds and the availability of a suitable research setting, or the resources for creating one. Regarding

[69] Quatrefages, "La Science et la Patrie," p. 41.

[70] Lacaze-Duthiers, "Le Laboratoire de Zoologie Expérimentale de Roscoff," *Association Française pour l'Avancement des Sciences Compte Rendu de la 8e Session, Montpellier 1879* (Paris: Au Secrétariat de l'Association, 1880), p. 767.

natural kinds, Georges Pruvot's "Essai sur les Fonds de la Manche Occidentales (Côtes de Bretagne) Comparés a ceux du Golfe du Lion" (1897), established a comparative inventory of the fauna in the region of Lacaze-Duthiers's two stations.[71] He explained that the current distribution of organisms was the result of a long historic process. Yet since naturalists were not present for this unfolding of events, he had to deduce it from the present order of things. By contrast, the forces which shaped the establishment of the very stations where Pruvot carried out his research were closely studied by their founder. Indeed, the process by which Lacaze-Duthiers assembled the sites for his stations reveals not only the complications of creating new centers of research, but served as the basis for a comparison between the culture and politics of two regions of France which were as remote from Paris as they were from each other.

On a visit to the laboratory, the botanist Jean Chalon described the stacks of onions piled up beside the ancient stone farmhouses which the farmers themselves carted to the ports of Roscoff, Morlaix, and Lannion. There they were loaded onto small ships bound for England. "For several days the growers became sailors,"[72] and once in England hauled the heavy baskets on their backs and became vendors, too. They conducted their business in broken English or their native Breton, thereby cutting out middlemen. The region was remote, unassimilated into the rest of France by language or sentiment. Even after the coastal region started to become a popular summer residence for Parisians, it still "preserved its picturesque and unspoiled simplicity."[73] The naturalists who came to Roscoff resembled the resourcefulness of the Breton farmers. But for the laboratory to be

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[71] Georges Pruvot, "Essai sur les Fonds et la Faune de la Manche Occidentale (Côtes de Bretagne) Comparés à Ceux du Golfe du Lion," *AZEG* ser. 3 t. V (1897), pp. 511–617.

[72] Jean Chalon, "Quelques mots sur Roscoff," p. 107.

[73] Charles Atwood Kofoid, *The Biological Stations of Europe*, p. 99.

successful, it meant assimilating its scientific culture if not into the fabric of local life, than at least into the urban fabric of the port of Roscoff. As if to mark the cultural contrast, Lacaze-Duthiers wrote bitterly that the Conseil Général of Finistère would have more readily accorded funds for the bestowal of a medal on a prized Breton filly than to support his research station.[74]

Looking back on its origin in a rented house, Lacaze-Duthiers wrote that it was impossible to imagine that the station would eventually occupy no fewer than five buildings, three of them lining the town's main square. At the same time, he was appalled at the resistance offered by the city to the station's growth when it should have welcomed the presence of an important institution of research. He confided to his private journal: "How much the rapacity of Roscovites have caused me troubles."[75] The station expanded "parcel by parcel" into the urban fabric, converting existing structures to its use. Comparing this pattern of growth to his experience at Banyuls, he wrote:

> Si la station de Roscoff, bien moins avancée que sa soeur puînée, eût été, dès son origine, conçue sur des plans exactement définis, et si les moyens d'exécution eussent été arrêtés et connus d'avance par le fondateur, il n'est pas douteux que le laboratoire Breton serait aujourd'hui mieux disposé et qu'il eût coûté moins cher.[76]

The task of converting a house, a school, and a fort into a scientific establishment presented considerable effort: constant changes to the plans led to "added expense and ever growing

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[74] Lacaze-Duthiers, *Enquêtes et Documents*, p. 5.

[75] Lacaze-Duthiers, Private Notebook "Station de Roscoff 1881," Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[76] Lacaze-Duthiers, *Enquêtes et Documents*, p. 26.

delays."[77] Arguably, Lacaze-Duthiers constructed the very conditions which the École was created to eliminate.

Unlike Roscoff, the municipality of Banyuls vied for the honor of welcoming Lacaze-Duthiers's winter laboratory to its Mediterranean shores. The Conseil Générale of the Pyrénées-Orientales saw the laboratory's potential as a part of the local economy and cultural life. Moreover, it was a means of connecting a region steeped in its local culture with the metropolis. How different a world it was from the rugged and primitive region of Brittany. Lacaze-Duthiers described the alluring vista of the bay of Banyuls as seen from the window of a moving train. The Chemin de Fer du Midi followed the coast on its way from Perpignan through Port Vendres and Banyuls and then into Spain. Narrating the train journey, Lacaze-Duthiers not only described the optical effect produced by the alternation of profound darkness and brilliant light as the train passed through tunnels, but his notebooks are punctuated by the precise time of his arrival and departure at each town. From the vantage of its train station high above the town, he could see that the railroad had brought much progress to the Banyuls and the region.[78]

The development of the laboratory at Banyuls differed in another essential way from Roscoff: it consisted of a new structure which was "perfectly suited to a defined goal."[79] Lacaze-Duthiers's earlier travels to the region replayed a familiar script of making do with available conditions of research. During an excursion of 1866, he received permission from the commander of Port-Vendres to set up a temporary laboratory in an uninhabited

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[77] Ibid., p. 26.

[78] Lacaze-Duthiers, "Les Progrès de la Station Zoologique de Roscoff et la Création du Laboratoire a Banyuls-sur Mer," *Archives de Zoologie Expérimentale et Générale* 9 (1881), p. 584; Lacaze-Duthiers, Private Notebook [1] "1879–1882," Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[79] Lacaze-Duthiers, *Enquêtes et Documents*, pp. 25–26.

barracks. The building, built upon a small peninsula extending into the well-sheltered bay, offered him all the conditions he needed for research. He believed the site was "predestined" to become the site for a zoological station. During his visit at the time of the Montpellier congress, he was able to entice the minister of education, Jules Ferry, to visit the port to discuss the possibility of making it a permanent station.[80]

While Ferry's ministry petitioned the military authorities for the cession of the barracks, a bout of typhoid fever broke out in the citadel of Perpignan, and its troops were evacuated and barracked in Port-Vendres; Lacaze-Duthiers's plans were temporarily stalled by the quarantine. As he would soon discover, finding a permanent place for his research establishment in a busy port would seemingly run counter to the function of the port itself. In particular, plans to build an inner basin beneficial to maritime traffic threatened to disturb the "veritable aquarium" of the existing port.[81] Lacaze-Duthiers's ongoing negotiations over a location for his station were the source of keen interest in the region, ultimately leading the municipality of Banyuls to formulate a proposal to attract the station. The municipality offered not only a highly desirable parcel site, but capital, and even a small research vessel.[82] The port of Banyuls is situated at the back of a large, natural amphitheater formed by one of the large geological notches formed where the Pyrénées finally terminate, plunging into the Golfe de Lion. The hills are terraced with vineyards and olive-groves set against a cerulean sky. The cape where the station was to be situated

[80] Lacaze-Duthiers, (1881), p. 570.

[81] Ibid., p. 576. Lacaze-Duthiers offered the example of the port of Marseille, which during this period underwent enormous development with the result that it became inhospitable to marine life.

[82] Extraits du Registre, Délibérations du Conseil Municipal de la Commune de Banyuls-sur-Mer, Séance du 26 juin 1881, Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

possessed many of the "ideal" conditions which Lacaze-Duthiers found during in Port-Vendres. In fact, upon learning of the offer, the municipal council of Port-Vendres made a counteroffer of a new site.

Given his experience at Roscoff, Lacaze-Duthiers's response was anything but muted: "Two neighboring locations, situated at the limit of France, zealously struggling to become the seat of a scientific center connected to the metropole. Does this struggle not demonstrate how warmly received the idea was?"[83] One American visitor to Banyuls commented on what a novelty it would be in America for two villages to compete for the honor of hosting a scientific laboratory.[84] Yet the competition revealed the desire on the part of the regional authorities to strengthen the tenuous relation of the Roussillon to the rest of France.

The desire to host an annex of a prestigious Parisian institution in this remote corner of France led to the step taken by the Conseil Général of Pyrénées-Orientales to provide Lacaze-Duthiers with a subvention of 20,000 Francs for the construction of a laboratory to be built either in Banyuls or Port-Vendres. It was Lacaze-Duthiers's choice. The Conseil's president described the Pyrénées-Orientales as a distant and unknown place within France. "Our department was marked by a dark spot on the map of France representing the degree of development of learning."[85] The statement reflected Charles Dupin's famous description of "la France éclairée" and "la France obscure" of his *Carte Figurative de l'Instruction Populaire de la France* (1826), which did so much to reinforce the cultural division of the

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[83] Lacaze-Duthiers, (1881), p. 573.

[84] George Dimmock, "The Arago Laboratory at Banyuls," *Science* vo. 2, no. 28 (October 26, 1883), p. 556.

[85] Lacaze-Duthiers (1881), p. 575.

North and South.[86] The laboratory was seen as a means of geographically redistributing the resources of higher learning. Though Lacaze-Duthiers was aware of such divisions, reporting how frequently he heard, "we are far from Paris, from the heart of France," his attention remained focused on the relative merits of Banyuls and Port-Vendres.

Looking ahead for a moment to a slightly later stage in Banyuls's history, in naming the station after François Arago, Lacaze-Duthiers capitalized on the famed astronomer's connections to the region. Indeed, the dedication of a statue of Arago in Perpignan in 1878 served as the occasion for Lacaze-Duthiers's first effort to discuss the creation of the laboratory with Ferry. Realizing the power of images, Lacaze-Duthiers noted that there was a portrait of Arago in town halls throughout the Roussilon. Arago's accomplishment as a scientist and as a Republican deputy were an ornament to the region.[87] By placing a reproduction of a bust of Arago in Banyuls's aquarium, Lacaze-Duthiers paid tribute to this dual legacy of scientific accomplishment and Republicanism. He noted that his title of "Member of the Academy," which he shared with Arago, prepared the welcome of a region so isolated from the seat of the Academy itself. By creating an intellectual genealogy, Lacaze-Duthiers connected the singularity of Arago's reputation in the region to the efforts of the metropolitan institutions to which his talents gave him passage.

The two ports presented a number of subtle differences which were significant if the laboratory was to become a permanent institutional resident. The port of Banyuls was the base for a "sedentary" fishing population. Dimmock noted that the fishermen sold their catch right on the beach, as opposed to bigger cities where it is immediately carted to trains

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[86] For a discussion regional divisions see Roger Chartier, "The Saint-Malo—Geneva Line," in *Realms of Memory, The Construction of the French Past*, I, pp. 466–496

[87] Horace Chauvet, *Histoire du Parti Républicain dans les Pyrénées-Orientales* (Perpignan: Imprimerie de l'Indépendant, 1909), p. 31.

destined for Paris. This gave the naturalist a chance to inspect the daily catch for unusual specimens.[88] By contrast, Port-Vendres was a place of "commercial trade and the business of transit," the expansion of its port already having threatened Lacaze-Duthiers's earlier plan. Its hectic comings and goings differed from Banyuls' population of "tranquil landowners."[89] On one hand there was a town of fishermen and vintners, on the other merchants and middlemen. Significant for its eventual identity, Banyuls was Lacaze-Duthiers's choice. While the municipality of Port-Vendres pledged its support, the question of the laboratory's emplacement still required a series of risky negotiations with a variety of administrations into which Lacaze-Duthiers was weary of entering.

Lacaze-Duthiers had learned his lesson from Roscoff. If his initial attraction to Port-Vendres was that it offered "a highly propitious location already ready and costing nothing,"[90] the port of Banyuls represented the responsibility along with the rewards of building a station which answered to the needs of research. Lacaze-Duthiers announced to the Académie des Sciences in May 1881 that he had chosen Banyuls-sur-Mer to serve as the "seat of scientific station connected to the metropole."[91] The mixed generosity and self-interest of the municipality paid off. If Banyuls was formerly a "pitiable village" where the fishermen lived off their meager catch, by the time Lacaze-Duthiers died in 1901 there were "cheerful villas" built all along the coast and throughout the valley.[92]

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[88] George Dimmock, "The Arago Laboratory at Banyuls," p. 557.

[89] Lacaze-Duthiers (1881), p. 577.

[90] Ibid., p. 572.

[91] Lacaze-Duthiers, "Création d'Une Station Zoologique Marine dans les Pyrénées-Orientales," CRAS t. XCII (February 14, 1881), p. 1026.

[92] Georges Pruvot, "Henri de Lacaze-Duthiers," p. 49.

Chapter IV

As historic case studies, Roscoff and Banyuls reveal important distinctions in the local and regional context in which they took shape as foyers of research. In this regard, another aspect of their planning makes them relevant to the investigation of strategies of distributing space. Namely, where Roscoff was an assemblage of improvised settings, Banyuls was deliberately built. In examining the stations in their embryonic stage, the focus was on their rate and pattern of growth as opposed to their final form. Both laboratories were assimilated into the École Pratique. With their foundations firmly in place, work in creating the intellectual, social, and disciplinary forms which comprised the scientific foyer could continue on an assured basis. The conditions were right for investment in a permanent establishment of research.

Chapter V

THE DOUBLE PROGRAM: PART ONE, RESEARCH

> It might well be that, owing to our insatiable appetite and desire for sensation, mere exclusion without some compensatory substitute, like the pictures on the wall, would drive a person mad or distracted more quickly than the chaos that reigns without. Still, it has not been beyond the bounds of human ingenuity to propound the virtues of the perfectly negative wall—a doctrine that would lead to the total eclipse of all things outside—Robin Evans, "The Rights of Retreat and the Rites of Exclusion"[1]

A peculiar set of object relations is established in a remarkable photograph of the research vessel *Roland II* under construction in the courtyard (shipyard) of the station at Banyuls (fig. 5.1). The building, though situated by the edge of the sea, has the words "Laboratoire Arago, Université de Paris" painted on its exterior wall; the words seem to

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[1] Robin Evans, "The Rights of Retreat and the Rites of Exclusion: Notes Toward the Definition of Wall," *Translations from Drawing to Buildings and Other Essays* (Cambridge: MIT Press, 1997), p. 46.

advertise that something is nominally amiss. Evidently the laboratory has in some sense been transported to the coast, deployed there by the univeristy of Paris. The ship, of course, should not be read as its means of transport, even if we know that building materials once served as balast for sea-going vessels. Rather, the image frames an intriguing connection between the identity of the laboratory as a place of research and function of the ship as a means of research. The juxtaposition of the two elements becomes legible once both are recognized as large-scale instruments. Where the vessel rides upon the sea's surface, allowing naturalists to trawl its depths, the station made a previously opaque sea visible by channeling it into its very confines.

In examining the role of the stations of Banyuls and Roscoff in mediating the experience of living nature, this chapter will examine how they were assembled as buildings and as instruments. Here an instrument is not meant in the narrow sense of say a microscope. Though like a microscope, the research station was not merely something through which nature was seen, but was an artifact of a paricular approach to seeing. Useful in this respect is Aldo Rossi's notion of architecture as "apparatus" (*apparecchio*). Through a reading of such common phrases as *apparecchiare la tavola,* meaning to set the table, he describes architecture as "the instrument which permits the unfolding of a thing."[2] In such a reading the building becomes a vehicle for an event. Considering observation and experiment both as events and as things permits us to underscore the fact that these complex acts took shape in particular structures. In arguing this point, we will consider how the stations managed the pertinent elements of experience from the scale of the station's region to the subarchitectural scale of the its furniture.

This research function, however, comprises only one half of the "double program" which Guadet identified as specific to marine stations; the following chapter will examine

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[2] Aldo Rossi, *A Scientific Autobiography*, trans. Lawrence Venuti (Cambridge: MIT Books, 1981), p. 5.

the other half of the program, that of habitation. Since Roscoff and Banyuls were annexes of the Sorbonne, the discussion here will begin with an analysis of the New Sorbonne which was designed to solve the chronic shortage of appropriately equiped spaces for teaching and research at the University of Paris. On a typological level, the stations will be compared to contemporary English and German examples; the comparison reveals the specific cultural role that architecture played in the evolution of the double program. In analyzing the plan of Roscoff and Banyuls, it is possible to reconstruct an encounter with the natural world. And here yet another sense "plan" is presented: an approach to managing the elements of time, place, and circumstance which were constituitive of the acts of observation and experiment.

THE NEW SORBONNE

In his eulogy to Milne-Edwards, the chemist and ardent Republican Marcellin Berthelot described the architectural and ideological transformation of the Sorbonne from an "ancient sanctuary of theologians" into a place for research and experiment.[3] The New Sorbonne, however, was long in coming and proved a mixed blessing for the faculty of science. Milne-Edwards, who in his final days frequently toured the massive work site, long sustained the hope that an earlier plan, conceived in 1855 by Léon Vaudoyer, would one day be realized. The plan would have alleviated the difficulties he faced as dean of science in finding adequate and well-equipped laboratories for his faculty.[4] Yet if the renovation of such a venerable institution and urban monument as the Sorbonne required decades to

[3] Marcellin Berthelot, "Notice Historique sur Henri Milne-Edwards," *Annales des Sciences Naturelles*, Zoologie, XIII (1892), p. 5.

[4] Milne-Edwards letter to Minister de l'Instruction Publique (March 8, 1870), Archives Nationales, series F^{17} carton 14531. The problem was related to how to designate the laboratory situated at no. 116 rue St. Jacques which formerly belonged to Paul Bert. Part of the space was attributed to Lacaze-Duthiers in compensation for a former laboratory he was forced to cede to another naturalist.

complete, by 1885 Lacaze-Duthiers had realized his intention of building "annexes" of the Sorbonne at Roscoff and Banyuls. The stations benefited from a flexibility in planning which arguably was impossible at the New Sorbonne, its dense packing of diverse faculties and functions compared by one observer to the planning of a trans-Atlantic passenger ship.[5] Though the prestige of these annexes initially derived from their connection to this metropolitan institution, they represented new possibilities for research which existed far beyond its perimeter.

For Lacaze-Duthiers, the connection between the Sorbonne and the world along shore was first made in Milne-Edwards's amphitheater. With the creation of research stations, the shore became a place to extend the primarily theoretical instruction offered in the amphitheaters of the Sobronne with direct experience of living nature. Equally, instruction in the amphitheater benefited from demonstrations on specimens collected at the shore and a knowledge of their vital circumstance.[6] But as annexes of the Sorbonne, the stations were not merely auxilliary to it. Rather, they overcame the very defficiencies which the design of the New Sorbonne was intended to correct. Embedded in Lacaze-Duthiers's claim that naturalists could find not only as good, but better arrangements for research at Roscoff than at the Sorbonne was a criticism of the long-promised "palace" that was to replace the "hovel" occupied by the faculty of science along the Rue Saint-Jacques. As things stood, he wrote, there was "neither air, nor light, nor the possibility of movement."[7] For the study of living nature, it was impossible for the researcher to set things in motion.

The architect of the New Sorbonne, Henri-Paul Nénot, wrote that few edifices presented in their general divisions such a complex program. He had a foretaste, however,

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[5] Maurice Caullery, "La Faculté des Sciences," in *La Vie Universitaire à Paris* (Paris: Librairie Armand Colin, 1918), p. 53-54.

[6] Lacaze-Duthiers, *Le monde de la mer et ses Laboratoires*, p. 18.

[7] Ibid., p. 24.

in his design for "An Athenaeum for a Capital City," which won the Grand Prix de Rome in 1877. His composition, though it was not judged to be brilliant, was nonetheless neat and compact. The programmatic elements were clearly modulated by the *enfilade* connecting a palatial entry hall to a greenhouse structure.[8] With the New Sorbonne, housing Athena became a far more complex affair, pushing the art and science of composition to its limits. The plan of the New Sorbonne included nearly five-hundred individually designated spaces, ranging from narrow preparation rooms to grand academic council chambers. The difficult combination of amphitheaters and laboratories was accomplished with a system of passages and stairwells betraying a high degree of grammatical precision.[9] Nénot also deftly managed the narrow limits of the Sorbonne's urban site, which involved incorporating Jacques Lemercier's magnificent chapel. With the suppression of the faculty of theology, however, the chapel ceased to be either the spiritual or architectural focus of the university. Rather, the New Sorbonne connected the seat of the university's overseers, the "center" represented by the academic palace, with the various faculties, the "provinces."

Returning to Lacaze-Duthiers's claim, he was not alone in criticizing the New Sorbonne for being an "academic palace." Inded, the science faculty formed a very distinct part of the palace precinct. With the architecture of its façade along the Rue des Ecoles derived from the classicism of the Second Empire, the academic palace had the status of an urban monument. The façades of the science faculty, by contrast, were of a polychrome brick construction inspired by the rational theories of Viollet-le-Duc. More was at stake, however, than the question of architectural character, over which Nénot in any case

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[8] Arthur Drexler, ed., *The Architecture of the Ecole des Beaux-Arts* (New York: The Museum of Modern Art, 1977), p. 259.

[9] There is evidence in the letters between Lacaze-Duthiers and Nénot concerning the arrangement of his lecture and preparation rooms of the difficulties the architect faced in fine-tuning his plan to the specific (and sometimes conflicting) needs of the faculty and the delays which resulted, Archives of the Académie des Sciences, Fonds Lacaze-Duthiers, carton 1790.

demonstrated a fair degree of masterly. Rather, the science faculty was conceived by Nénot as "a veritable factory."[10] How was a factory to be connected to the grandly ceremonial and elaborately decorated spaces of the palace? The laboratory spaces provided the air, light, and freedom of movement that Lacaze-Duthiers called for, but they were still bound by the compositions logic of the overall plan. Nénot's analogy of the science faculty to a factory stemmed less from their structural similarly, than from the fact that both were places of production. Arguably this function was incompatible with the architectural means at Nénot's disposal.

As seen by Lacaze-Duthiers and others, the task was to facilitate research, not to make a monument out of these facilities. What distinguished the monument from the laboratory or factory was the horizon of time and the changes it brought. As Guadet explained, at institutions such as the Sorbonne, the demands of the faculty become increasingly specialized. By working closely with an architect, the arrangement of each laboratory becomes an expression of an individual scientist's research program. Thus a scientist could only work and teach "in conditions determined by himself."[11] Yet in order for there to be progress in science, the younger generation must quarrel with their teachers; inevitably, the spaces which the younger generation inherets from its teachers are inadequate to their new research goals. In contrast to monuments, the purpose of which is to preserve a set of meanings, the arrangement of the laboratory must change with each generation and each advance in knowledge.

The physicist Pierre Duhem memorably dismantled the "absurd idea" of a "monumental laboratory" in an article aptly titled "Usines et Laboratoires."[12] The article

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[10] Henri-Paul Nénot, *La Nouvelle Sorbonne* (Paris: Armand Colin, 1895), p. 2.

[11] Julien-Azais Guadet, *Eléments et Théorie de l'Architecture* (Paris: Librairie de la Construction Moderne, 1901), II, pp. 292–293.

[12] Pierre Duhem, "Usines et Laboratoires," *Revue Philomatique de Bordeaux et du Sud-Ouest*, année 2, no. 9 (1 septembre 1899), p. 388.

revealed how the scientific laborer was displaced from the academic palace. Duhem reported of the inability of one of his students to find the space and equipment for his doctoral research in Bordeaux's faculty of science. The recently constructed faculty, he wrote, clothed the "working edifice" of science in constricting monumental garb. As a result, the student became "a vagabond of physics," forced to "beg" for proper facilities. Finally, a generous industrialist extended his "hospitality to an experimenter in distress, housing his instruments in an outbuilding of his factory." Incidentally, Duhem's rhetoric echoes in certain respects that of Lacaze-Duthiers, who referred to himself (seemingly without irony) as a "mendicant." The role of his stations, as he saw it, was to offer hospitality to visting researchers; the accomodation of the station put an end to the naturalist's intellectual vagabondage. Duhem went on to argue that his student's situation in the outbuilding of a factory would serve as a constant reminder not to separate the "true" from the "useful." Such a statement might be read more generally as the basis for the demand, also voiced by Lacaze-Duthiers, that all available resources be devoted to creating places of research, not to crafting their architectural image.

The actual object of Duhem's criticism was the new Academy of Bordeaux, designed by Charles Durand. The classical edifice is almost definitive of its type: the secular Republican University.[13] Indeed, Duhem's comments must be read as those of an ardent Catholic and anti-Republican, and not incidentally an ideological foe of Lacaze-Duthiers. To begin with, Duhem took exception to the figure of Marianne which replaced the allegory of theology, the faculty of theology having been supressed as part of the Repubican campaign of anti-clericism. On a more general level, he argued that instead of adorning the façade with sculpture, there should have been a clock, the "symbol of exactitude and

[13] See Claude Laroche, Dominique Dussol, "Les Facultés de Bourdeaux," in *La Sorbonne et sa Reconstruction*, pp. 201–222.

incessant activity." The purpose of the faculty of science was to set this activity in motion and regulate its outcome.

The façade not only failed to represent the character of the faculty of science but constricted the growth of science. According to Duhem, the architect mistook the "container for the content; science with the palace it inhabits." Even if Durand's faculty was a welcome addition to Bordeaux's urban monumental ensemble, Duhem wrote that it was not the purpose of a science faculty to ornament a city square. Incidentally, the square it fronted had been recently redidicated in honor of Louis Pasteur. It was necessary to judge the building by the work it accomplished, not by "the article devoted to it in a Baedecker guide."[14] The faculty needed not only to accommodate the current state of science, but remain open to the next generation of science. Duhem wrote balefully: "The palace they build today will become an iron collar tomorrow and a tomb the day after tomorrow." Science did not require a palace, but spaces which could be occupied and vacated according to the generational factors at work in science itself. Duhem imagined an institution with no fixed walls, but rather partitions which could be rearranged as disciplines changed.[15] Was not beauty to be found in the "perfect adaptation of a thing to its purpose," he asked of those who would complain that faculties conceived in this way would be ugly. Driving a stake into Nénot's effort of reconciliation at the Sorbonne, Duhem issued the rallying cry: "Pas des monuments, des usines!"

Describing Nénot's Sorbonne as a "two headed edifice," François Loyer wrote of the dissociation of culture and modernity which it evinced. The palace and the factory not only

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[14] Duhem, "Usines et laboratoires," p. 388.

[15] For a contemporary discussion of the issue of partitions within the social studies of science, see Bruno Latour, Steve Woolgar, *Laboratory Life, The Construction of Social Facts* (Princeton: Princeton University Press, 1979), p. 47.

failed to be synthesized but ended up in opposition.[16] Loyer describes a fissure that opened up between an experimental approach to architecture, which was that of science, and a sort of encyclopedism which was properly literary. As opposed to the impressive classical façade along the Rue des Ecoles, the science faculty lacked any monumental entry. Ironically, the two great scientific personnages who had persistently complained of the lack of proper space for their research lent their names to the internal passages which connected the palace to the dense precinct of laboratories, amphitheaters, and collections. Unlike the streets bordering the Muséum which recalled the names of its great resident scientists, the New Sorbonne was like a scientific city turned in upon itself. The compositional resolution of Nénot's plan meant that the Sorbonne was "finished" from the day it opened; there was no place for the next generation's Pasteurs and Bernards.

Tellingly, when a chair in the evolution of organized beings was earlier created by the city of Paris in 1888 for Alfred Giard, no space could be found for it at the Sorbonne. For a time, the course occupied the former field atelier of Jacques Soufflot, architect of Saint Geneviève.[17] It is fitting that a branch of science in formation would make use of a space which had been used to oversee a construction site. Ultimatelty, the urban, monumental, even palatial character of the Sorbonne provides an incomplete template for discussing the emergence of its annexes along the coast. The stations responded to a form of research which evidently could not be accomodated within the Sorbonne's walls. It is perhaps helpful to think of the stations as discreet elements of Nénot's plan which broke free and migrated to the shore. Released from the pressure of the New Sorbonne's dense urban site, they openly interact with the particularities of their new setting. Indeed, the image of the

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[16] François Loyer, "L'Architecture de la Sorbonne, entre Culture et Modernité, in *La Sorbonne et sa Reconstruction*, p. 92.

[17] Proces-Verbaux, Conseil Municipal de Paris (July 20, 1888), pp. 199–200, Municipal Archives, Paris.

factory of science also fails in this new context. Rather it is more productive to think of the annexes as the type of atelier of an on-site manager which Giard made use of in Paris.

CONSTRUCTING ANNEXES

The annexes built by Lacaze-Duthiers were neither palaces built of costly stone nor did they adopt the rational brick construction of the factory of science. Rather, they emerged out of and ultimately gave sense to their respectives places of research. The laboratory at Banyuls was constructed from stone excavated from the site; Roscoff was pieced together from existing buildings. Lacaze-Duthiers wrote of the buildings which comprised Roscoff as "far from offering the harmonious appearance and pleasant conditions one likes to find in an important state establishment."[18] Indeed, they did not so much represent the state as respond to a particular and changeable state of affairs. Framing a space of research which was nominally part of the Sorbonne, they punctured its façade opening a window to the sea.

This window replaced the pedagogic panoramas which decorated the amphitheaters of the New Sorbonne. With their decorative scheme reflecting the branch of research for which they were the pedagogic outlet, the amphitheaters served a dual representational purpose. The wall behind the lectern in the "amphitheater Milne-Edwards" where Lacaze-Duthiers taught was covered by Jean-Francis Auburtin's "Paysage au Fond de la Mer" (1897).[19] It was a vivid scene of a wide variety of bizarre creatures destined to arouse the curiosity of students. Yet through the intermediation of the research station, the amphitheater opened to the theater of nature itself. In giving structure to an extramural science, research stations arranged an entirely new setting of research. They provided the

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[18] Lacaze-Duthiers, "Les Amelioarations Materielles des Laboratoires Maritimes de Roscoff et de Banyuls en 1894," *AZEG* 3 (1895), p. 10.

[19] Jean Bonnerot, *La Sorbonne, sa Vie, son Role, son Oeuvre a Travers les Sìecles* (Paris: les Presses

means for encountering the seascape into which the painting on the amphitheater's wall offered only an illusory form of displacement. Appropriately enough, the passage from the Sorbonne to the coast was illustrated by Lacaze-Duthiers in a slide talk entitiled "Le Monde de la Mer et ses Laboratoires," given on the occassion of the Paris meeting of the Association Française (fig. 5.2).

The connection between the Sorbonne and Roscoff and Banyuls was literally telegraphic. Lacaze-Duthiers boldly claimed that if any member of the audience wished to conduct research at one of his stations the very next day, advance word would be sent along the wires, and all necessary preparations would be in place upon his arrival by train. During the first part of the talk, Lacaze-Duthiers led his audience on a "promenade" along shore, discussing the immense variety of marine invertebrates along the way. He projected slides of a number of these animals, only to redirect the attention of his audience to a living specimen moving about in a basin at the front of the room. "Aujourd'hui, la voilà vivante à Paris; elle vient de Banyuls."[20] Living nature had been transported along the same rail lines which conveyed the researcher to the coast. Lacaze-Duthiers invited his audience to gather around the table, "as if they were making an excursion to the sea."[21]

The second half of the presentation focused on the research function of Roscoff and Banyuls. At this point, Lacaze-Duthiers projected an image illustrating two workers at Banyuls in their fully (and identically) equipped "stalls," simple rooms framing a large window. Each naturalist was furnished with all that was required to carry out observation; nature, too, was near. The window had no curtains, which would "mask the superb view which unfolds before the eyes."[22] Or so explained Louis Boutan, who produced the first

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Universitaires de France 1935), p. 162.

[20] Lacaze-Duthiers, *Le Monde de la Mer et ses Laboratoires*, p. 11.

[21] Ibid, p. 2.

[22] Louis Boutan, *La Photographie Sousmarine* (Paris: Schleicher Frères, 1900), p. 119.

photographic "underwater landscapes" in the bay of Banyuls. Through the window can be seen the vast sea from which the specimens the naturalist was working on were taken. Within the space of the stall, living nature was subjected to his insturments and dissective gaze. Lining its walls were bottles of dyes used to prepare specimens, marking their passage into the domain of scientific vision.

The role of the wall and the window in distinguishing inside and outside was a fluid one. The station mediated its surroundings in a novel way, channeling into its confines the vital milieu of its experimental subjects. The diving helmet, the glass wall of the aquarium, the lens of the microscope were all surfaces with which these specimens came into contact, and through which they were visually penetrated. The station itself was an armature for these surface, keeping them in place and situating their particular mode of action. Considered as an instrument, the walls and windows of the station filtered external conditions. The station's plan represented the way in which these conditions were to be managed and incorporated into the research function of the station.

CONDITIONS

Like mariners and stonemasons, indeed all those whose livelihood depended on reading patterns of weather, the naturalists had to become expert in the conditions in which their research took place. It was only by putting workers inside factories with their monotonous work days that these conditions could be put out of mind.[23] In serving as an instrument of research, the stations had the opposite effect of making the naturalists mindful of the order of things beyond the its walls. But Lacaze-Duthiers two stations differed in a number of imporant respect. Roscoff and Banyuls not only had very different fauna, but the stations had to respond to dramatically different set of circumstances.

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[23] Michel Serres, *Hermes IV. La Distribution* (Paris: Les Éditions de Minuit, 1977), p. 229.

Chapter V

Lacaze-Duthiers wrote that a naturalist going from Roscoff to Banyuls would initially feel "out of his element" [*dépaysé*].[24] In analyzing the research function of the stations, it is necessary to begin by examining how the stations managed these conditions.

The naturalist visiting Roscoff, wrote Lacaze-Duthiers, needed to consider certain facts and make appropriate arrangements in advance. Upon his arrival, he could expect to find a supply of specimens necessary for his research. But his expectations needed to be based on the season of year and state of the tides. Lacaze-Duthiers issued tides tables and a map of the maritime distinct to each arriving naturalist. In this way, the naturalist had "in front of his eyes" the limits of collecting excurions which could be undertaken on any given day.[25] Research along the coast was not like in laboratories in cities which opened and closed according to regular hours. Rather the research routine changed daily according to the tides, weather, and season. On the eve of any excursion, the trajectory of the station's research was plotted.[26] The failure of the naturalist to take proper account of the coordinates of his research plan would result in his having "to wait without work." The "education" of the naturalist involved understanding the means by which specimens were collected and his own part in this task.

It was incumbant upon the naturalist to familiarize himself with atlases and indexes to the coast, which resulted in "an incontestable economy of time."[27] These reference sources were comparable to and often consulted in concert with train schedules. Lacaze-Duthiers writes of cross-referencing a tide table and train schedule in planning a quick

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[24] Lacaze-Duthiers, "Les Progrès de la Station Zoologique de Roscoff et la Création du Laboratoire a Banyuls-sur Mer," *AZEG* 9 (1881), p. 565.

[25] Lacaze-Duthiers, "Laboratoire de Zoologie Expérimentale de Roscoff, Compte Rendu des Améliorations et des Travaux de 1874 à 1878," *AZEG* 6 (1877), p. 324.

[26] Ibid., p. 330.

[27] Ibid., p. 325.

excursion from Roscoff to Morlaix, so that not an instant of research time would be lost.[28] Yet the program of a zoological excursion for students of the École des Hautes Études made clear where circumstnance could intervene on the regular order of events. Departing from the Gare d'Orléans at 7:15 Saturday evening and arriving at Banyuls 6:38 the following evening, the part of the excursion which adhered to railroad time (and controlled by telegraph) posed no problem. But a note at the end of the itinerary which included seminars, collecting trips, diving, and sightseeing made clear that conditions along the coast were far more variable: "L'exécution de ce programme, surtout en ce qui concerne les excursions en mer, est subordonnée à l'état du temps; il est toujours d'ailleurs susceptibles d'être modifié dans quelqu'une de ses parties, suivant le désir des excursionnistes, après entente avec le Directeur du laboratoire."[29]

The economy of time manifested itself in the daily schedule of the naturalists. It was necessary for the naturalist to see to all of his "conditions of existence," a phrase used by Cuvier to refer to an animal's adaptation to its environment. The very act of collecting along the strand, involving arduous labor in the open air, stimulated the physiological "economy."[30] Thus considerations of a purely material order such as food, rest, and proper clothing were essential to planning an excursion. Lacaze-Duthiers reports having seen numerous excursion go bad due to hunger and cold. In a characteristically homiletic vein, he recalled one of his first visits to Roscoff during the month of July when he was not prepared for the difference in temperature—he was forced to telegraph to Paris to have his heavier

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[28] Ibid., p. 325.

[29] Broadside, "École des Hautes Études, Laboratoire Arago, Banyuls-sur-Mer, EXCURSION ZOOLOGIQUE, du 26 mars au 9 Avril 1899, dirigée par M. Lacaze-Duthiers," Archives of the Station Biologique de Roscoff.

[30] Lacaze-Duthiers (1877), p. 328.

clothes sent.[31] Life at the station prepared the researcher for work in the field; conversely, effective field work provided the specimens the naturalist worked on upon his return to the station.

The station at Banyuls presented the naturalists with a very different set of working conditions. The most drammatic was that the Mediterranean has no tides. Despite the incredible transparency of its water and the resulting illusion that specimens might be directly grapsed from its depths, naturalists depended on trawling nets to gather specimens from the sea. Yet unlike the calculated research efforts at Roscoff, the use of these nets often provided "unforeseen pleasures."[32] There was no way of knowing what would be brought to the surface, even in familiar collecting grounds. The warm waters nurtured a remarkable variety and number of specimens, especially when compared to Roscoff. Serving as a "winter laboratory," work could continue at Banyuls when conditions at Roscoff became inhospitable. At Banyuls material life was tied to the glowing radiance of the Mediterranean, while life at Roscoff was organized around a daily, even hourly schedule. Roscoff's relative proximity to Paris meant that it could be visited short-term to accomplish specific research; at Banyuls, the naturalist spent the season. Indeed, the distinct "mores" of Banyuls corresponded in part to its distance from Paris. Banyuls was an enticing countryside where dreams of a seaside rusticity were apt to take flight.[33]

ASSEMBLING ROSCOFF

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[31] Lacaze-Duthiers, "Leçon d'Ouverture du Cours de Zoologie à la Sorbonne (Cours de 1873–1874)," *AZEG* 3 (1874), p. 5.

[32] Lacaze-Duthiers (1881), p. 565.

[33] See Alain Corbin, "Paris-Province," in Pierre Nora, ed., *Realms of Memory, The Reconstruction of the French Past*, trans. Arthur Goldhammer (New York: University of Columbia Press, 1996), p. 428.

Earlier it was suggested that Roscoff and Banyuls might be considered as detached elements of Nénot's plan for the New Sorbonne. Yet when their development is traced historically, the question of their architectural composition takes on a particular cast. This reflects Lacaze-Duthiers's attitude toward the efficacity of architecture itself. In fact, the composition of the station's is legible only when seen in terms of the patterns of research to which they gave form.

Lacaze-Duthiers's theory of architecture, if it may be called that, was contained in his reference to Aesop's fable of the "Crow and the Fox," and its lesson against courting flattery.[34] Lacaze-Duthiers regarded the banality of his stations as a virtue; not only did they avoid vain ostentation, but all available resources were directed toward furnishing the means of research (fig. 5.3). "The building should be very simple, nothing should be sacrificed to architectural ornament."[35] Creating comfortable working conditions and a solid construction were the only conditions which had to be met. This simplicity extended to his personal apartment at Banyuls, the furniture and decor of which consisted of what was absolutely indispensable.[36] At numerous rerpises and in various formulations Lacaze-Duthiers stressed that in his stations luxury has been replaced by comfort. The buildings are studies in unadorned necessity. Yet if Lacaze-Duthiers extoled the virtues of a sort of primitive simplicity, some visitors to his stations were less generous in their assessment:

> Le bâtiment est écrasé; sa façade nue n'est relevée par aucun pavillon, par aucun fronton, et l'ensemble général du laboratoire est lourd et disgracieux. Il eût été facile

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[34] Lacaze-Duthiers (1891), p. 14.

[35] Lacaze-Duthiers, *Enquêtes et Documents*, p. 16.

[36] Lacaze-Duthiers, "Les Laboratoires Maritimes de Roscoff et de Banyuls en 1891," *AZEG* 9 (1891), p. 312.

> de faire une construction plus élégante et tout aussi commode sans dépenser plus d'argent.[37]

This equation of style to cost, which was precisely indicative of Lacaze-Duthiers's sensibility, led to the inarguably impoverished architecture of the stations. This self-thought mendicant followed too religiously the dictum that the daily bread of science should not be turned into building materials.

Of the two stations, Roscoff was truly at the periphery of architecture. The house which served as the main block of the laboratory was the type of building to appear in a specimen book of traditional Breton architecture (fig. 5.4–5) From this kernel, the station was assembled "in pieces and parts."[38] with the addition of a school building, another smaller house, and a military installation. In terms of its outward appearance, it was an "agglomeration" which had the "most ordinary aspect."[39] Contemporary photographs of the Place de l'Église confirm Lacaze-Duthiers's impression (fig. 5.6). To this day, it is still difficult to detect in the row of traditional Breton buildings the presence of an important research institution. By contrast, the ornate steeple of the neighboring church was an unmistakable feature of Roscoff, especially as seen from the sea.

To astute observers, however, the plain appearance of the laboratory signified its status as an institution still in formation. Auguste Ménégaux, who conducted a tour of French marine research stations in 1910, noted that Roscoff did not have the "harmonious appearance and beautiful architecture which characterizes buildings designed by architects

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[37] Ludovic Martinet, *Banyuls-sur-Mer, Histoire Naturelle, Ethnographie, Climatologie* (Paris: G. Masson, 1883), p. 73.

[38] Lacaze-Duthiers *Enquêtes et Documents*, p. 5.

[39] Lacaze-Duthiers, "Sur les Laboratoires de Roscoff, Banyuls et Les Archives," *AZEG* 6 (1898), p. 14.

with diplomas from the state." [40] His statement presumed the involvement in such undertakings of the corps of "government architects" who were responsible for assuring the proper architectural character of civic and diocesan structures. [41] To be sure, Lacaze-Duthiers employed the engineers of the Corps des Ponts et Chaussées stationed in Perpignan to oversee the improvements of the port of Banyuls. But the research laboratory did not fall within the rubric of structures to which the attention of these architects was customarily directed. It was not a civic or state monument, but a building type which was still in the process of definition.

The identity and function of the laboratory were expressed through the modifications made to the existing structures which comprised it. These building were not "harmonized" in appearance but rather by their mutual adaptation to a common purpose.[42] Occupying the rear wing of a former grammar school, the station's research room was divided into eight identical stalls. The whitewash of the walls and the complete absence of any decorative elements gives the room an air of objectivity (fig. 5.7) But the presence of the original structures registers differently at various other places in the laboratory. The students' study room, for example, is dominated by an immense hearth and stone mantel piece, vestiges of the domestic space out of which the laboratory grew. The furniture of the room is grouped around the irregularly spaced windows; every effort was made to ensure that no space is lost.

It is on the "Plan Définitif" (1891), published almost twenty years after the station's founding, that a coherent set of intentions becomes apparent (fig. 5.8). The clarity of the plan effectively masks the piecemeal development of the station. The stark outline of the

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[40] A. Ménégaux, "Le Laboratoire de Roscoff," *Bulletin de l'Institut Général Psychologique* (1905), p. 77.

[41] On the formation and role of the government architect see, Barry Bergdoll, *Léon Vaudoyer, Historicism in the Age of Industry* (Cambridge: MIT Press, 1994), pp. 185–206.

[42] Pruvot, "Henri de Lacaze-Duthiers," p. 42.

drawing indicates the groupings of work and service spaces and the passages between them, rectifying the accidental nature of the station's growth. There are no longer any vestigial parts or services; even the picturesque qualities of the original buildings are subsumed into the overall structure. There is an intelligence to the plan that could not have been anticipated when the station began to grow in an aggregative manner. Indeed, the plan can be seen as a generator only after the fact of the station's composition: it explains how experimental conditions were arranged. It is an analytic tool which elucidates the distribution of the station's functions and its relationship to its surroundings.

In terms of the station's internal organisation, the two wings of the laboratory, one facing the sea and the other the Place de l'Église, seem to rotate about a pin-wheel formed by the Mironnet house. This small house contained the machine room which pumped seawater throughout the structure. A continuous corridor connects the buildings, leading from Lacaze-Duthiers's private study at one end of the aquarium, through the research rooms, the library, the students' rooms, and ending with the guardian's lodging. The passage moves on and off axis as the various services assume a greater or lesser place in plan. The passage is a flexible mode of communication. Externally, the deliberate alignment of the aquarium wing and the vivarium produces a visually complex sea wall. The aquarium engages a wall which encloses the garden, and culminates with an arched gate next to the guardian's residence, creating the station's inner precinct. An outer precinct is formed by the wall defining the terrace, the space between the station and the strand. Anchored in place by the diamond-shaped Batterie de la Croix, which juts out like a counterweight to the mass of the station, the terrace was the counterpart to the garden; a paved surface overlooking the vivarium and offering access to the strand, it was the station's foyer to the sea.

THE DESIGN OF BANYULS

In contrast to Roscoff, Banyuls was designed to be a research station (fig. 5.9–10). As such, it only further exemplified Lacaze-Duthiers's attitude toward the relative value of architecture. Indeed, he seems to have adopted in whole the opinion expressed by the education minister Ferry concerning what was useful and what was wasteful in the design of an institution. As reported by Lacaze-Duthiers, during their visit together to Port Vendres Ferry spoke:

> Vous aurez certainement à construire, et surtout pas de colonnes, car ce n'est pas avec celles qu'on fait des travaux; les bâtiments qui compléteront l'installation devront être faits en vue de la pratique, des études et non de l'esthétique, du luxe et du coup d'oeil.[43]

Accordingly, Lacaze-Duthiers asked his architect not to use columns, but rather to incorporate into the frieze bas-reliefs of langoustines and fish. Such a decorative program would in fact be realized with some delicacy in the facade of the laboratory at Sète, which was designed by that city's municipal architect. Banyuls received no such decoration; it was an unadorned shell.

The plans for the station were drawn by Eugène Ramon, a general councilor of the Pyrénées-Orientales, as a political favor to Lacaze-Duthiers. Lacaze-Duthiers wrote to Ramon of his desire for "a pretty and fine establishment."[44] By his own admission, however, the result was uninspiring, having the appearance of a "barracks," presumably like the one he occupied in Port-Vendres. The building itself is almost indistinguishable in style from Banyuls's small railroad station. While the local building commission recognized the excessive simplicity of the station's façade, in reviewing the design it nonetheless recommended that the architect remove the pilasters and capitals which were considered to

[43] Lacaze-Duthiers (1898), p. 15.

be too slender. It also recommended that he make every effort to balance the demands of economy with decorative finesse.[45] Boutan described the result as a large brick building of "great simplicity."[46] No molding or ornament interrupted the straight lines of its exterior walls. Even if luxury was "rigorously banished" in preference for comfortable work conditions, Lacaze-Duthiers nonetheless indicated in his notebook the need to talk to the architect about the lack of a water-closet.

Lacaze-Duthiers wrote that neither columns, nor grand perspectives aided in the production of solid research. To illustrate the aspects of the station which made it successful, he preferred to cite entries from its guest book. Pierre Van Beneden, whose father was the founder of the first marine research station in Europe, wrote that "the laboratory of Naples is without doubt more luxuriously installed," but that it did not offer the tools or the "richness" of Lacaze-Duthiers's establishment.[47] Rather, the station which was "executed with a great simplicity of means" performed an alchemy of sorts.[48] The inscription in "gold letters" on the façade of elaborate institutions were less significant than the resources of nature which were transformed inside the station into the stuff of knowledge, faithfully transcribed in the pages of the station's *Archives*. No doubt a "large and handsome façade" imposes on visitors a sort of esteem, Lacaze-Duthiers wrote, but

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[44] Letter Lacaze-Duthiers to M. le Prefet (Las Fons, September 18, 1881), Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[45] Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[46] Boutan, *La Photographie Sous-Marine*, p. 116.

[47] Lacaze-Duthiers (1891), p. 329.

[48] "Rapport" (May 2, 1883), signed: LD, Thomas Pacal (Maire), Eugène Bougouin (le secrétaire général de la préfecture), Bésiné (architect), Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

what impressed them more were the number and quality of publications which a "good and useful installation makes possible."[49]

Like Roscoff, the laboratory at Banyuls becomes more articulate on the level of the plan (fig. 5.11). The plan delineates not only the relationship of the internal space which was quite simple, but more importantly the connection of the laboratory to the elements of the site: the vivarium and the port. Along with the laboratory's system of internal circulation which flowed through its aquarium, these were crucial elements in connecting the laboratory to the sea. The organization of research is made strikingly clear in the relationship between the aquarium and the work rooms above, each occupying nearly the entirety of the building envelope. The large space of the aquarium is composed on the upper floor of eight identical research spaces among which the aquarium's specimens are parceled out. On the second floor was the library and conference room where the naturalists reunited after their solitary labors. Finally, the placement of the storage room opposite Lacaze-Duthiers's private study suggests that he was in a position to supervise the distribution of the station's materials.

The tripartite division of the façade was formed by drain pipes; the task of making the roof watertight added character to a structure which was organized around the circulation of water. Where for Viollet-le-Duc the country house defined a cycle of erosion which brings into being a rationality of construction, the station served as a conduit for and a reservoir of sea water.[50] Its plan described a series of general and local paths of circulation. The station itself can be read as a highly specialized prolongation of the natural jetty to which the station's research vessels were moored. As seen in photographs taken

[49] Lacaze-Duthiers (1895), p. 11.

[50] Jacques Gubler, "Viollet-le-Duc et l'Architecture Rurale," in Jacques Gubler, ed., *Viollet-le-Duc centenaire de la mort à Lausanne* (Lausanne: Musée historique de l'ancien-Evêché, 1979), p. 115.

from the town above, the picturesque sweep of the beach runs into the pier and vivarium of the station (fig. 5.12–13).

Banyuls was not only isolated but it was also remote. Thus with arrival of the steam vessel *Roland* in 1893—a "princely" gift of Roland Bonaparte—came the considerable task of making the station into a suitable port. Lacaze-Duthiers explained that unlike the simple steam engine inside the station's machine room which was relatively trouble-free, the steamship required constant maintenance and repair.[51] Since there were no dry-docks between Spain and Marseille, the station had to create its own.[52] The necessity of maintaining a steel-hulled ship also put demands on the station's existing services. Describing the importance of the atelier which was added to the station in 1884, Lacaze-Duthiers explained that being at the end of the world,the station had to "rely on itself"[53] (fig. 5.14). Boutan similarly wrote that in creating the station's electricity, the machine room overcame its distance from any large urban center.[54] The atelier not only helped outfit the stations' ships, but provided instruments and hardware for the laboratory; in fact, the balconies for the annex were produced in its forge. The station's chief mechanic crafted steam-driven winches for use during dredging surveys as well as the equipment Boutan used in his underwater photography. Of necessity, the station took on the trappings of a port. Lacaze-Duthiers decided to build the dry-dock within the vivarium for reasons of economy, safety, and ease. In terms of safety, it was a shelter within a shelter. A lock separated the dry dock from the vivarium, and another opening was made in the perimeter wall of the

[51] Lacaze-Duthiers (1895), p. 17.

[52] Lacaze-Duthiers (1898), p. 24.

[53] Ibid., p. 23.

[54] Boutan, *La Photographie Sous-Marine*, p. 124

latter to allow the passage of the *Roland*.[55] The station was no longer merely a way-station, but had become a center for producing and maintaining scientific artifacts.

ENGLAND AND GERMANY

Roscoff and Banyuls were glittering establishments in name only; their identity as laboratories of the University of Paris did not assure them the "grandiose appearance" of stations such as Plymouth, built by the British Marine Biological Association nor the Zoological Station of Naples which was privately funded by Anton Dohrn. Lacaze-Duthiers conceded that Plymouth was a "true monument," and that in comparison to the "magnificence" of Naples the annexes of the Sorbonne were indeed "very modest."[56] But he acknowledged his stations' lack of elegance in a nearly arrogant manner; he was convinced that in spite of their outward appearance, they assembled the most favorable conditions for work.

In contrast to Banyul's plain façade, the sculptor Adolf von Hildebrand contributed to the design of Naples. Indeed, the site for the station was given to Dohrn by the civic authorities on the condition that he construct a monument worthy of its prominent setting. Hildebrand collaborated on a series of frescoes on the station's interior with the painter Hans von Marées, who along with the Hildebrand was part of the group of German artists then in Rome.[57] The frescoes were not merely decorative, but the artists investigated the questions of vision, linking it to emerging aesthetic and scientific theories. The station was a monument of a new German idealism which looked again to the values of classical art. As Timothy Lenoir has discussed, vested in it was an idea of the unity of art, the sciences, and

[55] Lacaze-Duthiers (1895), p. 20.

[56] Lacaze-Duthiers, Le Monde de la Mer et ses Laboratoires, p. 36.

[57] See Harry Francis Mallgrave, "Introduction," *Empathy, Form, and Space* (Santa Monica: Getty Center 1994), pp. 29–32.

the senses.[58] To be sure, Lacaze-Duthiers did not possess the aesthetic sophistication of Dohrn. He showed a blind spot to the potential of his stations to embody a conception of research in a greater intellectual or cultural frame. Perhaps that was the task of the New Sorbonne.

THE AQUARIUM AT ROSCOFF

Crucial to the status of the station as an instrument of research was the aquarim, which was itself typologically a new architectural space (fig. 5.15–16). The central aquaria of Roscoff and Banyuls, and the research rooms to which they were attached were the stations' central programmatic element. Though the two aquaria served a similar function, they had a very different aspect. At Roscoff the aquarium comprised a semi-autonomous structure while at Banyuls it formed a principal interior room. In either instance, the aquarium was at once the most flexible and the most structurally coherent component of the laboratory.

Roscoff's first aquarium, built beneath an open-side shed in the corner of the station's garden, was "primitive" affair which only functioned when an attendant (or a naturalist) manned the pump.[59] The aquarium, its inhabitants, and those who tended it were all exposed to the elements. It had been built with an eye to the eventual displacement of the station. It was only after the station became definitive that a circulatory infrastructure was completed. In his plans for converting the Mirronet house into the station's pumping room, Lacaze-Duthiers indicated the movement of water with arrows, showing the direction of its flow throughout the structure. Indeed, the parceling of water had an important place in the conception of time's arrow. The water clock was the first

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[58] Timothy Lenoir, *Instituting Science, The Cultural Production of Scientific Disciplines* (Stanford: Stanford University Press, 1997), p. 176.

effective means of keeping time to overcame the natural limitation of sundials.[60] The transition from ill-defined time periods relating to the length of concrete tasks to abstract time periods corresponded to their use measuring the distribution in irrigation systems. The aquarium was an irrigation system of sorts; each basin was reserved for the use of an individual naturalist. Its contents represented his field of research. The parceling of the water into communal and individual basins allowed multiple research projects to take place simultaneously, each at its own rate and with its own duration.

The aquarium wing of Roscoff built by Charles Thomas in 1883 had a simple, wood frame structure, with trusses supporting a high pitched roof. From the outside, the structure appeared to be enclosed by a continuous wall of plate glass. The aquarium was a light construction (in both senses of the word) when compared to tradition Breton structures which housed the laboratory. The glass wall was thought by Lacaze-Duthiers to be a purely transparent surface, lacking any properties of reflection. He even compared the aquariums of Banyuls and Roscoff in terms of what light meant for their respective appearance. At Banyuls, where the aquarium was plunged in a theatrical obscurity, the light coming from within stirred the curiosity of visitors. At Roscoff, where sunlight was not in any case so vivid, the interior of the aquarium appeared continuous with its exterior. The result was that the public saw nothing of interest and as a result rarely asked to visit.[61] The aquarium wing served as the station's principle window, it was the station's means of possessing the sea visually and otherwise.

The aquarium at Rosoff was flanked by research cabinets, a large one belonging to Lacaze-Duthiers and on the opposite end of the wing one belonging to the station's preparer

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[59] Lacaze-Duthiers, "Les Progrès de la Station Zoologique de Roscoff," C.R.A.S. XCII (February 14, 1881), p. 1023.

[60] Gerhard Dohrn-Van Rossum, *History of the Hour*, trans. Thomas Dunlap (Chicago: University of Chicago Press, 1996), p. 23–24.

[61] Lacaze-Duthiers (1891), p. 306.

and another for the teaching master. A stair inside the aquarium led to Lacaze-Duthiers's private study, producing a processional aspect. Its placement recalled Cuvier's private cabinet which was appended to his famed Gallery of Comparative Anatomy. Both were spaces of productive intellectual retreat, separate from the activity of the laboratory. The stair landing produced the appearance that Lacaze-Duthiers was in a position to supervise work in the aquarium. But it is more likely that he savored the view from the room's balcony which offered a sweeping view to the sea. The cabinets of the preparer and teaching master, however, created a physical linkage between the aquarium and the rest of the laboratory. Lacaze-Duthiers wrote that there was a single corridor leading from one end of the laboratory to the other. The two cabinets form a control point, channeling and checking the movement of researchers and materials between the aquarium and the laboratory.

To see how the aquarium constituted a window onto the sea and a passage to the diverse spaces of the laboratory, let us return to the plan of Roscoff 1891. The deliberate alignment of the vivarium and the aquarium is striking. The two basins at the center of the space between the aquarium's glass walls resemble an optical device, poised to take stock visually of the vivarium; the tendril which connects them to the outer wall is in fact a water line, indicating the circulatory path connecting the structures. On the aquarium's garden façade, a low hedge marks the entrance, from which seem to flow a loose grouping of parterres. The picturesque quality of the garden seems to be separate from the work of observation taking place in the aquarium; indeed, the garden was conceived as a place of repose. The aquarium divides this cultured space from the terrace, which was the service area connecting to the vivarium and the strand. It was the site of daily changing arrivals and departures of naturalists and the unloading of specimens. The terrace is an open space on plan where the objects of nature which will be shaped through observation and experiment were sorted before being transferred to the aquarium..

Lacaze-Duthiers wrote that from the station's terrace one could access the vivarium, descend to the strand, and from there easily cross the bay to the station's aquatic park. He saw this as an ideal "reunion of circumstances."[62] The vivarium and park were at once extensions of the station's perimeter and were part of its natural environment.

The aquarium and vivarium were functionally connected (fig. 5.17). "These two structures are correlative of one another; they can not exist in isolation."[63] The vivarium was a large U-shaped basin extending from the station's terrace, in which large specimens could be "kept in reserve" regardless of "the state of the sea."[64] This store allowing there to be a plan of research in spite of varying conditions. The stone structure formed a small section of the sea with its own biological community. The enclosure developed diverse algae, which naturally aerated the water and served as food for herbivorous species, which in turn fed the carnivorous species. The vivarium also supplied materials for the station's "delivery service." Roscoff and Banyuls served as clearinghouses for specimens destined for faculties and laboratories in Nancy, Lille, Caen, Rennes, Paris, Grenoble, Dijon, Clermont Ferrand, Toulouse, Nantes, Tours, Grenoble, and others. Demands for specimens made in a timely manner could be fulfilled without disrupting the ongoing operations of the station. Indeed, the vivarium's one initial defect was that its water intake was occasionally fouled by the debris of the station, a nearby hotel, and the sewage of Roscoff itself.[65]

The park was an aquatic field located at a moderate distance from the station, but still under its direct care and surveillance. As Lacaze-Duthiers explained, it was simply a stretch of coast which had been made private propery, protecting it from the coastal

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[62] Lacaze-Duthiers, *Enquêtes et Documents*, p. 8.

[63] Lacaze-Duthiers (1881), p. 554.

[64] Lacaze-Duthiers, "Rapport à Ministre de l'Instruction Publique" (Paris Janvier 1896), Archives of the Station Biologique de Roscoff Archives.

[65] Jean Chalon, "Les Nouvelles Installation du Laboratoire de Roscoff," *Bulletin de la Société Royale de Botanique de Belgique* XLVI (1909), p. 227.

inhabitants who "pillaged" the strand during the seaweed harvest.[66] Unlike the aquarium and vivarium, which were constructed environments into which specimens were imported, the park was an existing vital milieu which was set aside by a wall, protecting it from intruders, human and otherwise. The wall defined a frame in which the naturalists could take stock of the growth of a specific biological community. The park was especially useful for studying animals which would die in an aquarium because they required a circulation of water and quantities of food which only the tides and currents could provide. Inside the enclosure were four long alleys formed of stones raised slightly above the sea floor. These created "shelters" fostering the growth and multiplication of specimens. The use of a numbering system allowed each stone in the gridded field to be catalogued and indivudually studied as a point of growth.

THE GROTTO OF BANYULS

Among the reasons for establishing a winter station at Banyuls was the rain and fog which "obscure the horizon" of Roscoff, making work in the aquarium and research rooms of impossible during much of the year.[67] It might seem surprising, then, to find the aquarum at Banyuls described as shrouded in a mysterious darkness, its windows covered with "large, thick curtains" (fig. 5.18–19). The comparatively ornate aquarium at Banyuls was markedly different from Roscoff, which was evidently a singular place of work. By contrast, the aquarium at Banyuls was "a real center of attraction."[68] During the warmest time of day throughout the high season, bathers came inside to "kill some time." As one

[66] Lacaze-Duthiers (1881), p. 552.

[67] Extract from the Procès-Verbaux des Séances Du Conseil Général du Département Des Pyrenées-Orientales (Séance ordinaire du 28 avril 1881), Archives Laboratoire Arago.

[68] Lacaze-Duthiers (1895) p. 29; during holidays, which were frequent in the region, the number of visitor could reach five hundred.

visitor noted, however, the bizarre animals in its tanks were there "patiently awaiting their turn to fall into the cruel hands of the zoologist and to expire under his scalpel."[69]

This same visitor compellingly narrated the sequence of impressions the aquarium made on him. Upon entering the room, all was silent except for the bubbling of water jets. All was dark except for the glow emitted from the tanks. Eight of these on the east side of the room were lit from above by electric light; the niches they occupied corresponding to the drawn windows on the other side of the room. The animals, he wrote, appeared to be caught in a "prison of crystal . . . the eye is astonished by this enchanting palace." After an initial state of wonder, the visitor slowly regains consciousness of his bearings.

In fact, two visits were required to judge the aquarium: one by the light of day and the other at night.[70] As Lacaze-Duthiers noted, nighttime corresponded to a more suggestive state when the imagination takes hold. But what place did these impressions have in the aquarium of a research station? Evidently this was not the same simple, well-lit room as Roscoff. Kofoid identified the model for such a range of impressions when he compared the aquarium of Banyuls to a grotto.[71] The aspect of the grotto is double: it was terrifying, inviting the visitor to abandon the world of light; yet in penetrating the darkness, the mind was enriched by the unexpected marvels encountered there.[72] In its more literal form, the naturalistic grotto figured prominently in the nineteenth-century emergence of large public aquaria. Before continuing with the discussion of Banyuls, let us look at a number of prominent examples.

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[69] Ibid., p. 3.

[70] Extract from Marguerite Sol, "Visite au Laboratoire Maritime de Banyuls," p. 9, Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie..

[71] Kofoid, *The Biological Stations of Europe*, p. 75.

[72] Léonard Amico, *Bernard Palissy et ses Continuateurs* (Paris: Flammarion, 1996), p. 49; see also Anne-Marie Lecoq, "The Garden of Wisdom of Bernard Palissy," in *The Architecture of Western Gardens* (Cambridge: MIT Press, 1991), pp. 75–76.

Chapter V

The Jardin de Réserve at the Exposition Universelle of 1867 was the site of a fresh and salt water aquarium (fig. 5.20–21). The building mass of the fresh water aquarium resembled an outcropping of jagged rocks with a broad waterfall sheltering its entrance.[73] In the marine aquarium, the building's structural grid was patterned to ressemble geological forms. Not only did it frame a series of enormous glass tanks which surrounded the room, but the ceiling was made of glass so that fish could be seen swimming overhead. It was as if a breathable space had been insterted into the dense fluid mass of the sea. The visitor entered a crystalline prison surrounded on all sides by a submarine landscape. Below the floor was a "crypt" where lobsters—"lovers of secrecy"—were kept.[74]

Like the grottoes of the picturesque garden Buttes Chaumont, which was among the Exposition's attractions, the aquaria were based on nature while not resembling anything in nature. Entered through an anfractuosity, the ersatz subterranean vault of the fresh water aquarium was supported by stalactite-form columns, the room dramatically lit from above. Shear plates of glass were set into the jagged walls, serving as windows opening onto the "panoramic background" of the large tanks. Though the aquarium produced a "charming spectacle," the fish were transported to Paris by rail from Huningue, Jean-Jacques Coste's experimental "factory of living alimentation." The life on display was the product of modern industrial processes. If artifice was central the conception of the classical grotto, these modern examples occupied the world of manufacture. In the intersection of spectacle and a form of mechanically reproduced living nature, the elements can be found the element of a truly fantasical vision.

As one observer noted, aquaria were among the most powerful instruments the experimenter could desire. They are for "large species what the microscope is for the

[73] J. B. Gassies, "Rapport Monographiques sur l'Aquarium d'Eau Douce de l'Exposition Universelle de 1867," Archives Nationales, series F^{14} carton 13610.

infinitely small."[75] This potential was realized in the aquarium built at Le Havre for the Exposition Maritime Internationale du Havre (1868). Though the exterior of the building was plain and "severe" in appearance, the inside was designed to resemble the famous basalt Fingal Grotto on Staffa Island, Scotland. Georges Lennier, the director of the natural history museum of Le Havre, wrote that he hoped visitors would pause in front of the columns of basalt to ask themselves if such forms existed in nature.[76] After public interest in the aquarium began to wane, the physiologist Paul Bert turned its lower floor into a laboratory in 1882.

Notably, Lacaze-Duthiers did not compare the aquarium at Banyuls to a grotto, but rather to a pisciculture establishment. He rued that the plain appearance of the aquarium at Roscoff would lead some to mistake it for a place where lobsters were raised for the market. This was precisely the purpose originally served by the basins which eventually became Coste's laboratory at Concarneau. Lacaze-Duthiers defended not only the purpose but the status of the aquarium at Roscoff when he wrote that it was the first such aquarium "devoted exlusively to theoretical studies."[77] At Banyuls, however, the aquarium was something more than just a work room. I was most "finely decorated room of the establishment. It was, so to speak, the reception salon, where the uninitiated could come to be welcomed into the curiousities of zoological science."[78] The aquarium had a marble wainscoting which formed a socle for the inset aquariums. The upper walls of the aquarium were whitewashed, giving the room a sterile appearance which contrasted with Roscoff

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[74] Edmond About, "Le Jardin Réservé, V. Les Aquariums," *L'Exposition Universelle de 1867 Illustrée* issue 5 (Paris: Commission Impériale, 1867) ed. Fr. Ducuing. pp. 70–71.

[75] J. B. Gassies, "Rapport Monographiques."

[76] G. Lennier, "L'Aquarium," in A. Blondin, ed., *Exposition Maritime Internationale du Havre, Rapports du Jury International et Catalogue Officiel des Exposants Récompenses* (London: J. M. Johnson and Sons, 1868), p. 559.

[77] Lacaze-Duthiers, *Enquêtes et Documents*, p. 2.

[78] Boutan, *La Photographie Sous-Marine*, p. 116.

where the transparency of the glass walls made vines from the garden seem like they were growing inside the aquarium itself. A row of marble pedestals along the west wall supported the aquarium tanks. These were not the low-sided models of Roscoff, which allowed the naturalist to work from above, but were more suited to displaying small marine ensembles. Befitting the reception room of a house, the aquarium had an air of formality.

Lacaze-Duthiers's notebooks reveal that he originally intended on filling the wall niche above each tank with shelves lined with glass specimen jars. All that was retained from this design for a "museum," as he called it, were the chalk boards on the piers betwenn the niches. Here naturalists could record their impressions or perform a demonstration. The wall text, as it were, was an ongoing commentary on the aquarium's changing inhabitants. Contrary to his views regarding the station's façade, Lacaze-Duthiers wrote that given its role as a public space, it was difficult to leave the walls of the aquarium unadorned. Thus a series of portrait busts of great men of science were placed around the room.[79] Along the back wall was Athena, the emblem of the Institut de France. While Boutan suggested that the busts were put there in order "to interrupt the monotony of the decor,"[80] such portrait statuary was a feature of libraries since the time of Pliny. As explained by the great librarian Naudé, such busts allowed the visitor to better appreciate a book by allowing the reader to study the countenance of its author.[81] This illusionistic dialog helps to explain the purpose of the aquarium. Though the space was meant for display, Lacaze-Duthiers seems not to have wanted to turn the aquarium into a museum. It was not the accumulation of conserved specimens which was of interest, but the presence of living specimens in their

[79] These included: Aesculpius, Descartes, Lavoisier, Antoine-Laurent and Bernard de Jussieu, Linnaeus, Forbin, Pascal, Ducouédie, Duhamel, Réaumur, Daubenton, Buffon, Cuvier, and Lacépède.

[80] Boutan, *La Photographie Sous-Marine*, p. 117.

[81] For a recent discussion of library statuary see, Malcomb Baker, "The Portrait Sculpture," in David Mc Kitterich ed., *The Making of the Wren Library* (Cambridge: Cambridge University Press, 1995), pp. 110–132.

vital milieu. In observing them, the visitor is invited to criticize, amend, or even contradict the words of the great men of science. Living nature provided the topic of informed discussion among visitors. An arc lamp with a large reflector was used to illuminate the aquariums during evening demonstrations; each tank could became the setting for a pedagogic discourse.

Not incidentally, the acquisition of the statues revealed the uncertain cultural status of the station itself, especially with regard to known types of scientific establishments. Lacaze-Duthiers had initially made a request to the ministry of the Beaux-Arts, which produced a catalogue of castings and reproductions. The catalogue might well be compared to the station's own delivery service as a means of disseminating models for the purpose of study. As a bureaucratic matter, the director would not fill Lacaze-Duthiers's request until he answered a questionnaire regarding the "nature of the establishment" in which the castings were to be put. He wrote to the Préfet of the Pyrénées-Orientales to inquire:

> 1. le genre dans leque peut être classé ledit établissement. S'agit-il d'un musée d'histoire naturelle, d'un établisseent de pisciculture, etc.?
>
> 2. à qui appartient le laboratoire. Est-ce un établissement communal? Est-il au contraire la propriété de M. Lacaze-Duthiers. Où est-il installé?[82]

Lacaze-Duthiers responded by indicating the laboratory was indeed an annex of the Sorbonne, that it was underwritten by the state, and was established in order to explore unknown regions of the coast.[83]

To answer the inquiry question more fully, we might add that Banyuls was neither a natural history museum nor a pisciculture establishment; its aquarium was something of an anomaly. It was not a working space such as the aquarium at Roscoff. Rather, a separate

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[82] Jean-Gabriel Gigot, "Les Origines, la Création et les Premières Années du Laboratoire Arago de Banyuls s/Mer,"*Cerca* no. 20. (1963), p. 290.

room which was off-limits to the public was established for that purpose. In this room, study basins sat on simple cast iron tables instead of the marble stands; there are no objects on display, but rather a cabinet containing instruments and work materials. Indeed, Lacaze-Duthiers defended the added expense of the main aquarium, writing that it actually cost the laboratory nothing.[84] Even if it served as the station's salon, comfort was not to be sacrificed to good appearances. Lacaze-Duthiers took "moral" refuge in the fact that the room's most elaborated decoration was a gift to the station, namely, a cast of the Venus de Milo. It was given by a lover of antiquity who, upon visiting the aquarium, decided that Venus had no better place than the living creatures of the sea. As one visitor described it: "in the middle of this silent sanctuary of science, in an imposing semi-obscurity, the lofty white statue appeared like a fantom."[85]

If the aquarium put living nature on view, it also looked good in pictures; it was a room designed to be photographed. The images of the aquarium in the *Archives* suggest its pride of place, as well as an unstated connection to the cultural institutions of the capital. Unlike photographs of Roscoff, where naturalists are seen working at the table-top aquariums, the aquarium at Banyuls is empty. In one image, the Venus literally turned to the camera; Lacaze-Duthiers explained in the caption that the engraver mistakenly reversed the way it was faced. But the room's grand air was dissipated in another image which never made it into the *Archives*. In a group portrait at the base of the statue, a student in the back row mugs for the camera, looking to the Venus with mock adoration. A visit to the aquarium at Banyuls served as one of the scientific excursions organized during the September 1887 meeting of the Assocation Française pour l'Avancement des Sciences in

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[83] Lacaze-Duthiers, Private Notebook "1886," Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[84] Lacaze-Duthiers (1891), p. 362.

[85] Sol, "Visite au Laboratoire Maritime de Banyuls," p. 7.

Toulouse. One visitor, noting that the tour took place late in the evening, greatly admired the room's electric lights. Yet the light also revealed Lacaze-Duthiers searching the faces of the group for signs of approval, his own face showing signs of "anxiety."[86]

FURNITURE

Having looked at the siting of the stations, and the arrangement of their principal rooms, the discussion of how they served as instruments of research can proceed to the scale of their furniture. Here the notion that the instrumental aspect of architecture is akin to the setting of a table is shown to be more than just a figure of speech. By furniture we refer to the comforts the researcher enjoyed at the station. Furniture, from the verb "fournir," means to provide, or to supply. Furniture makes the body comfortable, unaware of itself, allowing the mind to concentrate on external objects. Just as the station arranged the researcher's relation to external circumstances by making him minful of them, its furniture produced a greater "mindfulness."[87] In another sense of the word, the naturalist was made comfortable at these stations where all of his material needs were provided gratis.

The stations contained a variety of specialized items of furniture. The table-top basins of the aquarium, for example, allowed the naturalist to assume a posture of observation above the water's surface. From that position, he could work on specimens while they remained in their living milieu. But the most elaborate grouping of furniture was the swivel chair and U-shaped desk place in the room of each researcher (fig. 5.22). The American visitor Dimmock stated that once having become accustomed to this set-up, he

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[86] Henri Filhol, "Excursion Faite à Banyuls par la Section de Zoologie, les 27 et 28 Septembre 1887," *Association Française pour l'Avancement des Sciences, Compte Rendu de la 16me Session, Toulouse* (Paris: Au Secrétariat de l'Association, 1887), I, p. 270.

[87] Elaine Scarry, *The Body in Pain* (New York: Oxford University Press, 1985), p. 39.

was never at ease with any other arrangement.[88] The swivel chair has a place in the archeology of comfort, specifically the development of "nomadic" furniture. In discussing this term, Siegfried Giedion writes that in French the word *meuble* and the collective *mobilier* originally referred to transportable goods. To be movable meant not only that a piece of furniture could be taken from room to room, but that it accompanied its owner wherever he went.[89]

In the nineteenth century, moveability becomes a part of the furniture itself. Describing the emergence of chairs for highly specialized tasks, he wrote "the best posture for any given moment is the constant aim, differentiated mobility, the means."[90] The chair allowed the naturalist to turn to the diverse research tasks which were themselves connected to different functions of the station. The left table was connected through the aquarium to the sea, a microscope was placed on the center table in front of the room's window, the writing and drawing which took place in the right table ended up in the station's library once published in the *Archives*. The aquarium was connected to the library through a circuit which had the researcher's desk and chair as a vital link.

At Arago, where the library was much better furnished than that at Roscoff, the room had a large central table, covered in felt to protect the bindings of frequently consulted tomes. The library represented the literal terminus of the station's activities. There the drawings and descriptions that the naturalists made in their studies could be compared to the published literature. Lacaze-Duthiers wrote that working on living specimens was enough to dispel the baseless impressions given books produced by naturalists working from preserved specimens as opposed to living nature. The library also represented a starting

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[88] George Dimmock, "The Arago Laboratory at Banyuls," p. 558.

[89] Siegfried Giedion, *Mechanization Takes Command* (New York: Oxford University Press, 1948), p. 271.

[90] Ibid., p. 406.

point: it served as a guide to future avenues of research. In the library the naturalist came face to face with the product of his labor. In this space composition and criticism took the place of collecting and dissecting (fig. 5.23). The successive spines of the *Archives* marked the continuity of work which the station was established to facilitate. The success of Roscoff in this respect was demonstrated bibliometrically by one of its visitors. The Dutch naturalist Pierre Francotte compiled a table of the arrival and departure dates of his countrymen who had worked at Roscoff between 1876–1905, which was keyed into an extensive list of publications. The expanding field of experimental zoology was cross-referenced to its institutional sources.[91]

The various research spaces of the station can be classed either as individual or communal. Writing that the upper floor of Banyuls resembled a "monastery," Lacaze-Duthiers underscored the corporative nature of even individual research. If the research rooms were perfectly alike, they were equally distinct.[92] They provided the naturalists with a sense of "withdrawal" into his own private space and thoughts over the course of his research.[93] Each researcher enjoyed "entire liberty of opinion, work, and exposition."[94] His room was in effect a scaled-up version of the instrument-case Lacaze-Duthiers used during his own travels. Inside the case was a number of well-labeled boxes, packed so that everything inside was "immediately at hand."[95] The rooms, according to Lacaze-Duthiers,

[91] Pierre Francotte, "Les laboratoires de Naples (Station zoologique), de Roscoff, de Banyuls, de Concarneau et de Villefranche à l'Exposition de Liége," *Annales de la Société Belge de Microscope*, t. XXVIII, fasc. 1 (1907), p. 26–28.

[92] Lacaze-Duthiers, "Les Laboratoires Maritimes de Roscoff et de Banyuls en 1891," *AZEG* 9 (1891), p. 327.

[93] Lacaze-Duthiers (1895), p. 27.

[94] Lacaze-Duthiers (1874), p. 7.

[95] Ibid., p. 7.

were "spacious, perfectly lit . . . without any luxury, but comfortably funished, offering the most favorable conditions of study."[96] They met the demands of research and nothing more.

The specialized research furniture provided the naturalist with the necessary comfort to project himself intellectually into his research as well as to handle the objects of nature. His chair allowed him to adopt different postures of work throughout the day as his research task evolved. He turned from observation, to dissection, to drawing, to reading. In each instance, the table had been set. The arrangement of the station's furniture—the act providing—promised comfort but not luxury. The plainness of the stations themselves served as an outward sign that no sacrifice had been made for the sake of appearance.

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[96] Ibid., p. 5.

Chapter VI

THE DOUBLE PROGRAM: PART TWO, HABITATION

> [U]n savant qui arrive à Roscoff, pourvu qu'il en ait fait la demande en temps utile, peut se faire descendre par la voiture publique à la porte du laboratoire et être absolument parlant, installé queques instants après son arrivée. Il n'a plus qu'à choisir le restaurant où il ira prendre ses repas, et, à Roscoff, le choix n'est pas grand.[1]

Central to Lacaze-Duthiers's conception of Roscoff was that the station provide lodging to all visiting naturalists. Unlike the difficult days of yore that Lacaze-Duthiers was so fond of recalling, when the naturalist spent all his inner resources in arranging proper conditions of work and in finding a hot meal at the end of the day, the visitor to Roscoff could leave all such concerns at the door. The facts of habitation, the second half of the double program, were intrinsic to the research function of the station. As such, they did not escape Lacaze-Duthiers's analysis. In his final published report on the development of

[1] Lacaze-Duthiers (1877), p. 321–22.

Roscoff and Banyuls, Lacaze-Duthiers singaled his awareness that for years the pages of the *Archives* had served as a "detailed balance sheet" of their internal organizational.[2] For Lacaze-Duthiers, I argue, the domestic arrangements of the station was a means of instilling a research discipline in his visitors. As temporary residents of at the station, naturalists not only dwelled on the premises of their research, but were socialized as members of the household. The individual naturalist no longer had to rely solely on his own inner resources, but in the exchange his research were incorporated into the domestic order of the station.

This chapter examines the program of habitation at Roscoff and Banyuls in a variety of lights. Though Lacaze-Duthiers claimed to extend hospitality liberally, there was a price to be paid by all who accepted it. Where the previous chapter compared the architecture of Roscoff and Banyuls to Plymouth and Naples, here the manner in which naturalists paid for their stay reveals important conceptual differences regarding the conduct of research. As will be shown, the house rules, both implied and explicit, also reflected important aspects of the political and social situation outside the station. To examine this fact, it will be necessary to create our own balance sheet of what might be called the cost of living at these research stations. Yet as a home away from home for a few days or even a whole season of the year, the stations did not merely define a naturalist's work day. Like a domestic foyer, they also served as a place of repose. This aspect of the habitation, I argue, represents a significant complementary component to the notion of the station as an instrument of research.

REMAINING IN PLACE

The original full-time resident of Roscoff was not a naturalist, but a guardian. If the purchase of a house in 1876 marked the first step in the permanent establishment of the

[2] Lacaze-Duthiers (1895), p. 34.

station, its proper maintenance depended on there being someone "present on site."[3] The post of guardian was a natural extension of the duties carried out by the mariner Lacaze-Duthiers hired to stay on during the winter months to keep the station's embarkation in service.[4] This mariner soon became an able collector, and in this capacity kept the station's specimen service active during the months when naturalists were at home, so to speak, at the faculties where deliveries were made. He also prepared the laboratory for the arrival of these naturalists at the beginning of the season. The upkeep of the station was an essential task which none of the visiting naturalists could be expected to shoulder.

From this original guardian, the station's service soon grew into a crew which included three marines who saw to all aspects of the establishment. Arguably, the "division of their time" and labor according to the changing daily and seasonal needs of the station provided practical evidence for the theoretical contention that the household was the original site of social specialization. In more concrete terms, the crew was responsible for all the materials and equipment which were essential to the naturalists' work. Their labors in effect constituted a precondition for that of the visiting naturalists; they set the table, so to speak. Yet the sensibility that commodity was to replace luxury in the design of these stations held equally for how their services were to be rendered. Naturalists did simply make use of these services. Rather, during their stay they were taught to anticipate and even moderate their needs in accordance with the station's domestic economy.

Lacaze-Duthiers juxtaposed life in a hotel where one was among strangers to life at the station where researchers worked individually but together. Some visitors argued that

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[3] Ibid., p. 343.

[4] Lacaze-Duthiers, "Le Laboratoire de Zoologie Expérimentale de Roscoff," *Association Française pour l'Avancement des Sciences, Compte Rendu de la 8e Session, Montpellier, 1878* (Paris: Au Secrétariat de l'Association, 1880), p. 767. The first grant of 600 Francs allowed him to maintain the service crew throughout the year, a second grant of 1500 Francs allowed him to purchase a larger embarkation.

the bed chambers on the upper floor of the station could be put to better use as "true laboratories." But the arrangement offered an "incomparable convenience in work." The researcher could go from his bedroom to his work table to the aquarium at any time; the naturalist was free to dwell on his work and literally dwell in his workplace. Lacaze-Duthiers was sensitive to the fact that communal living was not to the liking of all. But he noted that there was "a real charm in intimate living."[5] The subject and method of his research was the visitor's to decide. Lacaze-Duthiers's role was simply to extend the station's hospitality to "those who desire it and ask for it."[6] There was a limit, however, to what Lacaze-Duthiers considered a legitimate demand.

After Carl Vogt planted doubts in his mind about the appropriateness of lodging naturalists at Roscoff, Lacaze-Duthiers planned Banyuls on a different basis. He considered the fact that Banyuls "lacked habitation" as the basis for an experiment in the role lodging played in the conduct of research.[7] The experimental subjects were the naturalists who visited Banyuls after having become accustomed to conditions at Roscoff. More often than not, he reported, they expressed regret at not being able to "live beside their objects of study, to no longer be able, at any moment of day or night, to descend from his bed room to his work table."[8] Vogt, who visited Roscoff on several occasions in the mid-1870s, endorsed an effort to construct a "casino" at Roscoff, where his family, who traveled with him, might be comfortably placed.[9] Yet Lacaze-Duthiers explained that in the isolated

[5] Lacaze-Duthiers (1877), p. 322.

[6] Ibid., p. 322.

[7] Lacaze-Duthiers (1895), p. 4.

[8] Ibid., p. 4.

[9] Hermann Fol, "Le Laboratoire de Roscoff en 1883," *Revue Scientifique de la France et de l'Étranger* ser. 3 no. 14 (October 6, 1883), p. 419. Fol wrote that everyone was at their liberty, and if a researcher showed up with his entire family and chose to stay at a hotel and show up at the laboratory only at work time that was entirely up to him. Just because some

regions where research took place, there was often "little hospitality" to be had. The comments he received from the naturalists who unwittingly participated in his experiment tended to express the desire to be lodged in the station, instead of being "obliged to go into the village" of Banyuls.[10]

With the installation of seven bedchambers at Banyuls, naturalists were finally able to enjoy the same "sequestered life" as at Roscoff.[11] The simply but comfortably furnished bedrooms were installed in the station's attic. Yet it was not their spare furnishings which caused Lacaze-Duthiers to describe them as "monkish." The description reflects the retired labor of the naturalist, now that he was freed from the need of going back to the village at the end of the day. Such conditions were conducive to the sort of sustained effort which was necessary for a naturalist to make best use of a short stay at the station. The reward for forgoing "luxury" was a complete portfolio of drawings; this, it may be recalled, was the same measure Quatrefages used in judging the productivity of successive stations during his exploration of the coast. Finally, the station's small dining room allowed the naturalists to gather for meals. In furnishing this aspect of communal life, the station was no longer merely a place of lodging but became a true residence.[12]

Lacaze-Duthiers was led to reconsider his experiment in (non) habitation at Banyuls after reading an article in the British journal *Nature* entitled "Toilers of the Sea."[13] The article compared Roscoff to the Plymouth marine station. Earlier, the superintendent of Plymouth wrote to Lacaze-Duthiers stating that like Roscoff, its purpose was "to offer

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did not need the sort of hospitality Roscoff offered, that was no reason "deprive" those for whom it served an inestimable advantage.

[10] Lacaze-Duthiers (1898), p. 27

[11] Ibid, p. 18.

[12] Lacaze-Duthiers (1895), p. 27.

[13] "The Toilers of the Sea," *Natural Science* n. 33, vol. V (November 1894); the title no doubt refers to the English translation of Hugo's novel of the island of Guernsey.

space and conveniences (under certain conditions) to students who may wish to investigate problems of purely scientific interest," and secondarily to aid the fisheries.[14] Yet the model for the station's classical façade as well as its fee structure was Naples. The naturalist Ray Lankester, who was the driving force behind Plymouth, had worked at Naples on numerous occasions and was favorably impressed.[15] Indeed, the article's contention that Plymouth was "finer and more richly equipped" than Roscoff failed to disturb Lacaze-Duthiers. He ignored the question of Roscoff's lack of finesse, replying instead that it had accommodated far more researchers than Plymouth. Yet the significance of the article was that it identified the reason why so many researchers came to Roscoff: the ideal of liberality with which its hospitality was dispensed.

What distinguished Roscoff and Plymouth was the cost of living and of working. At Plymouth, the visitor had to pay for his research table, materials, lodgings in town, and a gratuity to the station's attendants. At Roscoff, by contrast, all is free; the visitor was simply expected to leave a gratuity. All gratuities were given to the director to be divided evenly among the station's attendants. In this way, there would be no question as to a naturalist's generosity, which might otherwise compromise the level of service he received.[16] Some foreign naturalists, Lacaze-Duthiers wrote, were uncomfortable with this system; they told him: "We would like to pay; this liberality, this gratuity disturbs us."[17] By paying

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[14] Letter Walter Heape to Lacaze-Duthiers (Plymouth July 20, 1887), Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

[15] On Lankester and the founding of the British Marine Biological Association, see Joseph Lester, *E. Ray Lankester and the Making of Modern British Biology* (London: British Society for the History of Science, 1995), p. 111.

[16] Some students were not in a position to leave anything, and nothing was though of it. Others, who had means, left considerable tips, which Lacaze-Duthiers would have acknowledged publicly, but for the "rule of silence" which he observed in such matters. He added, though, that those who left substantial tips could be assured of the gratitude of the direction.

[17] Lacaze-Duthiers (1895), p. 8.

directly, the argument went, they could be freer in their use of materials and in the demands they put on the station's service. The naturalist had a right to demand whatever he was willing to pay for, even if the cost was onerous. But just as importantly, such an arrangement would free him from having to observe the terms of hospitality which accompanied the offer of lodging at Roscoff or Banyuls.

Naples operated under a very different set of terms. As one observer noted, it was unlikely that its "rich and expensive convenience can be furnished to zoological visitors without any pecuniary compensation.[18] At Naples and subsequently at Plymouth, naturalists worked at "tables" which were rented by their respective national governments; specimens were simply supplied upon demand. As a result, Lacaze-Duthiers argued, a researcher's knowledge about the specific circumstances from which these specimens were taken was limited. By contrast, at Roscoff and Banyuls naturalists came to know "the stations, the positions, the homes" of the specimens which they took an active part in collecting.[19] To be sure, Lacaze-Duthiers recognized that the advanced researchers who came to his stations on a tight schedule needed to have specimens simply supplied to them.[20] But the question of the cost to be borne by researchers working at Naples was not Lacaze-Duthiers's concern alone. Writing as the reporter of an international committee convened in 1872 to promote the founding of marine stations, Dohrn explained that a public aquarium would subsidize Naples's operation, but that a degree of "money-speculation" was necessary to ensure the laboratory's scientific budget.[21] But the underlying issue was

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[18] G. Mathus Whipple, "Report of the Committee Appointed for the Purpose of Promoting the Foundation of Zoological Stations in Different Parts of the World," *Nature* V (April 29, 1872), p. 362.

[19] Ibid., p. 329.

[20] Jean-Louis Fischer, "L'Aspect Social et Politique des Relations Épistolaires entre quelques Savants Français et la Station Zoologique de Naples de 1878–1912," *Revue Histoire de Science* XXXIII, 3 (1980), p. 230.

how the station accommodated the needs of researchers rather than satisfied their wants. The ability to make this distinction constituted part of the education the station offered.

The station represented a circumscribed economy in which the demands of any individual visitor had to be balanced against the overall needs of the laboratory. All such determination were made with regard to available resources at any given time. The expense borne by the laboratory could be lowered by charging fees to visitors, as was done at Plymouth and Naples. But the French custom of "gratuity" meant that researchers were not in the habit of paying for the very "air they breathe." The arrangement held that once a visitor was admitted, he was given total liberty of work, his research room was entirely his own domain, without any say from the direction. "Absolute equality exists among all the inhabitants of the laboratory," all of whom are seen by the direction simply as researchers.[22]

The station played host to naturalists of varying status. At the top of the social and intellectual hierarchy were naturalists who were "expert in the art of original research." Below them were licentiates, who conducted semi-autonomous research leading to their doctorate. The lowest rung consisted of Lacaze-Duthiers's students from the Sorbonne, as well as students from departmental faculties. In a separate category were naturalists who visited the station simply to make collections.[23] Inevitably, there were complaints on the part of "experts" who resented having to share space with student visiting the coast for the first time in order to "witness *in visu*" what they learned in the classroom. But accommodations were made for all of their diverse needs.

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[21] Anton Dohrn, "Report of the Committee, consisting of Dr. Rolleston, Dr. Sclater, Dr. Anton Dohrn, Professor Huxley, Professor Wyvile Thomson, and E. Ray Lankester, for the foundation of Zoological Stations in Different Parts of the Globe," *Report of the Forty-Third Meeting of the British Association for the Advancement of Science* (1874), p. 409.

[22] Lacaze-Duthiers (1877), p. 358

[23] Ibid., p. 323.

Foreigners as well as Frenchmen, Lacaze-Duthiers claimed, would find all that they needed in terms of optical instruments, dissection tools, reagents, etc. Upon arrival, each researchers made a list of all the materials for which they could anticipate the need. Given the ample quantities of supplies, specimens, and instruments laid in store, it was unlikely that anything would be denied them. In the case something was lacking, the director claimed that it was his pleasure and "duty" to procure them immediately.[24] At the station, the researcher would find himself literally "surrounded by conditions which put at a distance any care of its material organization."[25] The basis of intellectual freedom was freedom from want. The sufficiency of means was essential in Lacaze-Duthiers's mind for ensuring a sort of intellectual voluntarism. Students and researchers needed to know that they would not suffer materially through their choice of a particular area of research or theoretical position.

Yet the problem of competition, conflict, and demand for limited resources played a part in the vetting process by which visitors were selected for the station. Lacaze-Duthiers demanded that a research abstract be submitted with each application, in part to ensure that the station was ready to meet their needs. But it was also necessary to anticipate "inevitable clashes" which occur when two or more researchers are working on similar topics. In this event, there were two likely outcomes: either the researchers come to the same result, which means that one of them could have been better occupied on a different topic; or, the dispute which ensues over contradictory results becomes disruptive to life within the laboratory. Neither scenario, Lacaze-Duthiers wrote, was of benefit to science.[26] Yet he was not opposed to competition. In fact, competition encouraged the mutual emulation of good research practices, raising the overall level of production in the laboratory.

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[24] Ibid., p. 358.

[25] Lacaze-Duthiers (1891), p. 270.

In making use of the station's resources, researchers were bound to a social contract. Its stipulations were an important part of the research discipline for which the stations provided the physical and moral structure. The terms of the station's hospitality obligated the researcher to be mindful that the conditions in which he worked, though freely given, be put to best use. This obligation held equally for all of his fellow researchers.

All the material wants of the naturalists would be met by the station, but only in "proportion" to what was actually needed by them. Some naturalists consumed too much material as a result of "habit or negligence." This pattern of misuse put an intolerable strain on the station's budget.[27] The abuses of a small number of naturalists forced limits to be put on the liberality with which materials were dispensed to all. Those visitors who felt offended, Lacaze-Duthiers wrote, had themselves to blame. "Abuse alone determines the limits placed on the quantity or the nature of things demanded."[28] Each researcher was at his liberty, but not beyond what could be borne by the station which hosted twenty or so visitors at a time. If the direction failed to put constraints in place, then eventually "liberality takes the form of license." Once resources are misspent in this manner, any amount soon becomes insufficient.[29] Lacaze-Duthiers noted that a number of stations had been set up according to the ideal of complete liberty, but that eventually all of them were brought under a set of rules. Individual consumption was closely watched to ensure the well-being of the household.

In the light of the economic and moral discipline which was instilled in the station, it is revealing to return to the question of the station's daily research excursions. In the previous chapter, tide tables and maps were discussed as the means for planning these

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[26] Lacaze-Duthiers (1877), p. 359.

[27] Lacaze-Duthiers (1891), p. 268.

[28] Ibid., p. 270.

[29] Ibid., p. 357.

excursions; itineraries were based on changing external circumstances. Here the excursion can be viewed from the point of view of the station's changing social composition. The places the ship visited and the order in which they were visited was a matter of accord among the station's visitors. What the naturalists shared was a regard for the precariousness of their time; the planning of these excursions taught them to balance this regard for self with a regard for others.

When the station was fully occupied, it was difficult to "conciliate all the wants and all of the needs" of the researchers, even when the time and labor of the station's service was prudently divided.[30] Indeed, the employment of the service merely reflected the more general patterns of work in the station. Thus the question was how to "organize the excursion in a manner which was the most fruitful for everyone."[31] The use of the term "organize" is hardly incidental in this context. The household was fashioned as a social organism in which particular wants are subordinated to general need. In this act of organization, which was borne differently by the researchers and the station's direction, was progressively realized a community of shared expectation. The itinerary of the research vessel was an extension into space for the purpose of research of the social ordering of the station.

Each day the station's research vessel was called upon to visit diverse points along the coast, each of which represented a particular conditions for research. This meant being in two or more place at the same time, or within the cycle of a single tide. The itinerary of the daily excursions could be read as a plot of research demands both met and delayed. Even the best plan of research caused some researchers to suffer "loss of time." Let us recall that Lacaze-Duthiers initially expressed concern that the comfort and convenience the

[30] Lacaze-Duthiers (1877), p. 324.

[31] Ibid., p. 328.

stations offered to naturalists would diminish their ardor for work. The fact was, however, that the natural limit of the stations' resources forced naturalist to become conscientious of how their own research could be accommodated within the daily changing working life of the stations. For each excursion, one naturalist was designated to be the captain: "the ship is under his orders."[32] Anyone could accompany the excursion, but all are "subordinated to his research goals; the following day it is another naturalist's turn.[33] The pilot one day become a passenger the next; one day he directs events, the next he merely follows them. To make best use of his time, the naturalist needed to learn to benefit from both points of view.

MAKING ENDS MEET

Lacaze-Duthiers's notebooks reveal the extent of his own preoccupation with expense, recording as they do the cost of his meals, hotel rooms, train tickets. Yet his talent for thrift was evident in the purchase of a rifle range abandoned by the municipality of Banyuls. The purchase was made with funds he had "prudently set aside in case of an unforeseen need."[34] The wood structure was dismantled and reassembled in the forecourt of the station where it served as a store for the station's fuel, as well as a garage for the carriage which shuttled visitors and materials between the laboratory and rail station. A simple act of economy resulted in the acquisition of a new facility which in fact served a vital function in protecting the station's supplies.

The illustration points out that in analyzing the function of the station, the ordering of consumption needs to be balanced with the facts of production. In this respect, Lacaze-Duthiers instituted a number of ways by which the resources allocated to visitors benefited the station itself. In this way, the station's research products became the means for

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[32] Ibid., p.333.

[33] Ibid., p. 333.

extending the scope of its future research. For example, if a visiting naturalist discovered a new species or interesting specimens, it was requested that an example be left for the station's collection and for that of the Sorbonne. Even while aiding the research of its guests, the direction kept a portion for itself. The station was "to improve materially" from its own hospitality.[35] With each contribution, the fauna of Roscoff and Banyuls became increasingly better catalogued, allowing future researchers to benefit from savings in time and effort. Visitors to the stations do not simply consume its resources, but help to replenish them.

A further expectation was placed on visitors to the stations, one which had important implications for the construction of the stations' identity as research institutions as well as for their development as resources for research. All naturalists who stayed at Roscoff or Banyuls were asked to publish their work first in the *Archives*. As a literary record, it was analogous to the contributions visitors were expected to make to the station's collection of specimens. It was in the pages of the *Archives* that the research stations themselves took shape. The series of reports on the stations' progress written by Lacaze-Duthiers over the course of thirty years captured the development of Roscoff and Banyuls in minute (one could say obsessive) detail. From one installment to the next, new rooms, wings, as well as landscape modifications were shown as successively realized. The value Lacaze-Duthiers placed on hospitality was given concrete form in his unceasing efforts to extend their resources.

In the *Archives*, he deliberately shaped the stations' past through a system of images.[36] His articles included photographs, engravings, as well as plans and drawings of

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[34] Lacaze-Duthiers, (1898), p. 25.

[35] Lacaze-Duthiers (1877), p. 360.

[36] For a discussion of the making of corporate images, see David Nye, *Image Worlds, Corporate Identities at General Electric* (Cambridge: MIT Press, 1985), p. 4–5.

the stations and their context. He used long captions not only to narrate visits to the stations, but to correct distortions which the images themselves occasionally produced; this practice included pointing out features which had been left out of the picture. In the drawings and plans, different line weights were employed to indicate the present, past, and future outlines of the station. He even included in his text references to earlier editions of the *Archives*, giving the reader the opportunity to compare the current state of the station to an earlier image or plan. His purpose in all this can be read as much in terms of the desire to perfect these instruments of research as creating a portrait of material increase.

HOUSE RULES

Having discussed the terms of the station's hospitality in relation to the wants and needs of researchers, let us now turn to how it functioned as a locus of socialization. For in discussing Roscoff and Banyuls as habitations, there can be no mistaking Lacaze-Duthiers's role as a paternal figure transmitting his political and institutional values to his visitors. Indeed, with the ministry of Jules Ferry, science became the higher belief of a state fervently pursuing the politics of anti-clericalism. The staunchly Republican naturalist Alfred Giard, for instance, wrote that marine stations should be build where churches were formerly consecrated.[37] Instead of making pilgrimages to the holy land, it was time to organize scientific expeditions to unexplored regions along the coast. Lacaze-Duthiers himself was unwittingly drawn into these debates in May 1888 when he received a darkly menacing letter from Duhem, the embattled Catholic physicist, accusing him of wielding "sinister influence" on behalf of fellow Republic academics.[38]

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[37] Harry Paul, The Edge of Contingency, *French Catholic Reaction to Scientific Change from Darwin to Duhem* (Gainesville: University of Florida Press, 1979), p. 59.

[38] Stanley Jaki, *Uneasy Genius, The Life and Work of Pierre Duhem* (Boston: Martinus Nijhoff Publishers, 1984), p. 94.

The house rules, so to speak, of Roscoff and Banyuls betray the complications which attended the notion of hospitality in the face of contemporary social reality. Painted on the wall of the aquarium in each station was Lacaze-Duthiers's motto: LA SCIENCE N'A NI RELIGION NI POLITIQUE. Though the sentiment seems the essence of a neo-Enlightenment attitude toward knowledge, it did not translate into the development of an ecumenical community at either station. Indeed, the circumstances surrounding the founding of Roscoff put a strain on the call for a place of science free from external values and prejudices. Lacaze-Duthiers was explicit about the part Roscoff was to play in the "regeneration" of French science following the debacle of Sedan. The research station was an advanced outpost in an "intellectual movement" which the war had set afoot.[39] Yet more damaging than these (ultimately excusable) expressions of nationalistic sentiment was his unyielding reluctance to allow subsidies for French students to study at Dohrn's laboratory. Nor were any German students allowed into his stations.

Dohrn himself reported that upon hearing of a proposal by the French government to rent a table at Naples, Lacaze-Duthiers theatrically threatened to destroy Roscoff, quit his professorship, and return all of his honors.[40] Politics was not kept from science; indeed, it threatened to bring down its very edifice. Lacaze-Duthiers's attitude toward Germany became a source of embarrassment, especially toward the end of the century with the formation of international scientific congresses which fostered cooperation on large-scale projects of research. It was only four years after Lacaze-Duthiers's death that Maurice Caullery became the first Frenchman to study at Naples. In light of these facts, the list of rules issued to all visitors to Roscoff takes on an added significance. Its articles clearly laid out the conduct which was expected of visitors as well as Lacaze-Duthiers's supervisory

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[39] Lacaze-Duthiers (1874), p. 2.

[40] Fischer, "L'Aspect Social et Politique des Relations Épistolaires entre quelques Savants Français et la Station Zoologique de Naples de 1878–1912," p. 229.

role. As may be expected, these included precise instructions on the use of materials and the visitor's liability for all the instruments he used over the course of his research. But the final article warned that no one was allowed to enter the station "WITHOUT AUTHORIZATION OF THE DIRECTOR OR HIS REPRESENTATIVE."[41]

If the house rules of Roscoff and Banyuls fostered a research discipline, Lacaze-Duthiers's example instilled another lesson which had more general social significance. His preoccupation with the domestic management of the stations could have served as the very model of the state-sponsored virtues of the petite-bourgeoisie.[42] Based on the simple virtues of saving and economy, the civic ideology of the Third Republic was ultimately utilitarian in nature. In providing a setting for research, Lacaze-Duthiers recapitulated the values which were nurtured around the table of a well-ordered bourgeois home.

COUNTRY HOUSES

The role played by the country house type in the formation of the tradition of working by the sea warrants a brief excursus at this point. As a preceptor for a family in Caen, it will be recalled, Cuvier had the opportunity to naturalize along the coast during the periods when the family took up residence in their country near Fiquainville. In fact, Cuvier's access to the resources he wanted and needed as a naturalist depended on his commute between the city and the country. But it is not this historic legacy alone which makes a comparison between the research station and the country house pertinent. For just as the country house was arranged for the "domestic liberty" of the family, as Charles Garnier described it, the research station assured the naturalist's "freedom of work."

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[41] "Règlement," Archives of Roscoff Marine Station,"Laboratoire de Roscoff, Archives of the Station Biologique de Roscoff.

[42] Jean-Marie Mayeur, Madeleine Rebérioux, *The Third Republic From its Origins to the Great War 1871–1914* (New York: Cambridge University Press, 1987), p. 87.

Freedom from the closed quarters and harried life of the city were intrinsic to the realization of either goal. But equally as important was the fact that the house and the station were designed with a highly deliberate regard to their natural setting.

The emerging status of suburban villas, country houses, as well as sea-side cottages was widely discussed in the decades in which Lacaze-Duthiers's stations were realized. Among the most influential sources of ideas and images was the architectural journalist César Daly's *L'Architecture Privée au XIXe Siècle* (1863). Dedicated to the Baron Haussmann, Daly's book proposed model homes and new models of living at a moment when the dust was still swirling from Haussmann's radical reordering of Paris, which alienated it from its own residents. Daly explained that as an object still in the process of formation, the suburban villa could not be defined by a word with a fixed meaning. He began instead by describing the social transformations which gave rise to it. Most importantly was the "revolution" which produced the bourgeoisie destined to occupy these homes.[43] The "bourgeoisie of moderate fortune" was be the stewards of the middle landscape.

The design principle underlying the villa was articulated by Daly as: "the harmony of the edifice with the character of place."[44] The nearer the house was to the city the more it adhered to the "regime of urban discipline."[45] Conversely, the further the house was from the city the more it could be arranged according to domestic comfort. The asymmetry of the country house was not an act of fancy, but resulted from a rigorous "calculation" of how to take best advantage of the particularities of place. The house responded in an intimate way

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[43] César Daly, *L'Architecture Privée au XIXe Siècle*(Paris: A. Morel et Cie, 1863), p. 20. On the social dimension see Monique Eleb-Vidal, Anne Debarre-Blanchard, Architectures de la vie privee : maisons et mentalites: XVIIe-XIXe siecles (Bruxelles: Archives d'architecture moderne, 1989).

[44] Ibid., p. 23.

[45] Ibid., p. 22.

to its "site and surrounding nature."[46] Of course, one of the principal means or orienting the house towards its environment was through its exposures, from which the occupant derived the unexpected visual pleasures of the changing scene. The influential writers on the suburbs Isabey and Leblan noted in this respect that finding joy in such a view is "one of the most sought after agreements" of the country house.[47] To be sure, the orientation of the research station to nature was not simply a question of arranging pleasurable views. Rather, its windows and walls as well as its aquarium and vivarium framed highly specific exposures to the sea. In certain respects, the station transported the regime of urban discipline to the coast; it represented the imperative placed upon the naturalist to make best use of the exposures the station carefully arranged.

The domestic order of the stations was the premise for the ordering the naturalists sought in nature. But going back to Cuvier, the country house was not the naturalist's regular dwelling. Indeed, what unified discussions of the country house in its many guises was its relationship and relative proximity to the city. In this regard, Garnier made a useful distinction between rural habitations which were occupied "temporarily" by city dwellers and those which were "constantly occupied" by country folk.[48] The station's service played the role of permanent tenants; they assured within the workings of observation and experiment "the harmony of the edifice with the character of place." Their ongoing labor allowed naturalists, the station's temporary residents, to enjoy complete liberty of work. The stations confirmed Daly's prediction that each type of urban architecture would eventually have its counter-part in the country; his list of examples included the Parisian universities which already had branches "in the extra-mural zone."

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[46] Ibid., p. 22.

[47] Léon Isabey, Leblan, "Introduction," *Villas, Maisons de Ville et de Campagne, Composées sur les Motifs des Habitations de Paris Moderne* (Paris: A. Levy, 1867), n.p.

[48] Garnier, *L'Habitation Humaine*, p. 828.

Chapter VI

THE NATURE OF REPOSE

The discussion of Roscoff and Banyuls as places of habitation has so far emphasized the organization of the work day. But just as important were the periods of repose necessary for the naturalist to replenish his intellectual and physical resources. Indeed, Lacaze-Duthiers's self-conscious desire to distinguish his stations from bathing establishments and other resorts which were beginning to proliferate along the coast poses the question of how the stations provided a respite from the hectic life of the city. The fact that the library at Banyuls included not only scientific works, but also a whole range of literature "to relax the mind after an assiduous and sometimes painful labor" emphasized the complimentary role the stations played as places of rest.[49] This section examines the various meanings and forms of repose which were intrinsic to the program of habitation.

A notion of repose first appeared in Lacaze-Duthiers's writing not in a discussion of scholarly retreat, but wrapped in bellicose terms. In his opening course at the Sorbonne in 1873, Lacaze-Duthiers announced that his new station at Roscoff would contribute to the "regeneration" of French science. Comparing the wars among nations to the struggle for life which takes place in nature, he explained that a vanquished people takes the offensive and works to repair its losses while its enemy "begins to take its repose."[50] By liberating intellectual and material force, the "energy which slumbers" are reawakened. A more philosophical, even poetic notion of repose can be found in Lacaze-Duthiers's subsequent writings.

Work in the station was assiduous. In order to resolve a question of embryology, for example, the naturalist would follow its development under a microscope for hours at a

[49] Lacaze-Duthiers (1891), p. 313.

[50] Lacaze-Duthiers (1874), p. 37.

time, repeating sets of observations over days or even months, preparing slide, drawing and taking notes, all in the effort to capture a fleeting phenomenon. In Lacaze-Duthiers's mind repose was the necessary complement to this type of activity:

> à la fin de la journée on ne pensera guère aux distractions mondaines; car on est souvent à bout de force et, dans les instants de repos que donne le manque de lumière, on réfléchit et pense bien plutôt aux transformations, aux progrès du développement qui s'accompliront pendant la nuit, et aux choses qu'on verra ou qu'on espère voir le lendermain.[51]

In this and other passages, Lacaze-Duthiers limned the intimate life of the mind. In part, repose was the extension into the psychological realm of the concern for comfort which the station's furniture represented in the material realm. Repose was not only a way of repairing the mind but preparing it for the following day's work. It involved rest and reflection.

Lacaze-Duthiers understood the balance of work and pleasure as a feature of the design of his stations. "Il faut bannir des stations le luxe et l'exagération du confortable, sinon l'ardeur se ralentir ou s'amollit, et l'on en vient . . . à passer un été pour voir ce que l'on pourra bien faire l'année suivante, si ce n'est même pour faire une saison de bains de mer."[52] Repose was an active and creative impulse which extended the naturalist's research; it was not a state in which his attention to research problems at hand went entirely slack. In his lectures, Lacaze-Duthiers insisted that his stations were not places where the student would idle away his vacation period bathing and taking in the sun. Lacaze-Duthiers spoke of the visitors to the neighboring bathing establishment as possessing an "idle curiosity." Rather the station was the site of cultured retirement, where the naturalist could pursue his

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[51] Lacaze-Duthiers (1891), p. 341–342.

[52] Lacaze-Duthiers (1891), p. 349.

research free from the demands of his academic post. For the student, it represented an opportunity to sharpen the sensibilities which had been awakened for the first time in the class room.

The workings of the researchers' consciousness figured onto the topography of every day life at the stations. Lacaze-Duthiers's comparison of the research rooms of the upper floor at Banyuls to a cloister recalls not only a sort of religious seclusion, but a system of partitioning the day. The "orderly and punctual life" of the cloister, Lewis Mumford wrote, is not native to man. Rather, clock time had become man's "second nature."[53] Liberality of work meant the doors to the laboratory were never locked; the naturalist could go from his bed to his work table at any time of day or night. The absence of a regulating clock did not mean work was carried out at a casual pace; and nighttime did not always mean the end of the work day. Indeed, Lacaze-Duthiers publicized the lighting apparatus which allowed researchers to carry out microscope work even in conditions of fog, rain, or darkness. Yet the cycle of work and rest ran counter to notions of round-the-clock productivity. Lacaze-Duthiers recommended instead that when his forces were spent as dusk settled, the researcher take a moment to read "a few beautiful pages of our great poets."[54]

At Roscoff, the central mechanical regulator for work was the cycle of the tides. The period of the great tide, when the water level was the lowest, was the most active at the station. While the grueling work of collecting goes on, little research in the station takes place. Only after harvesting the strand did the naturalists seek "repose" in their cabinets. This meant that they could begin the sedentary labor of observation and experiment.[55] The

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[53] Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace, and Company, 1934), p. 16.

[54] Lacaze-Duthiers (1891), p. 342.

[55] Lacaze-Duthiers (1877), p. 331.

cycle of the tides balanced "corporal" exercise along the strand with the "work of the mind" in the laboratory.[56]

But it was not only external determinants such as the tides which fixed the naturalist's schedule. Lacaze-Duthiers noted that the station's physical isolation meaning there were few outlets for recreation. In choosing the sites for his stations, its isolation was important. It agreed with "naturalists by vocation" who savored the riches of nature more than "agreements of worldly life."[57] Even as the station became more developed, spaces were set aside for contemplation. In his hours of repose his mind wanders along paths which his labors have opened up for him. At Roscoff, "a well sheltered garden" offered to the inhabitants of the laboratory "a sheltered place to promenade in moments of repose."[58] At Banyuls, a hallway running between the research rooms extended out over the roof of the machine shop, where the electricity for the laboratories lights is generated, to a plateau carved into the native rock.[59] From there the naturalist had an awesome view to the sea, which he could appreciate in a moment when sensibilities were not directed to uncovering its secrets.

Clues to the fuller meaning repose had for Lacaze-Duthiers can be found in his own country house, which figures fondly in his personal writings as a retreat from the complexities of his hectic professional life. Lacaze-Duthiers purchased the small property in Dordogne, known as Las Fons, soon after the death of his parents, so as not to cut himself off from "melancholic charm" which he associated with the countryside of his childhood. The house could be described as what Gaston Bachelard called a "resting

[56] Ibid., p. 330.

[57] Ibid., p. 342.

[58] Lacaze-Duthiers (1881), p. 559.

[59] Boutan, *La Photographie Sous-Marine*, p. 119.

place." Its physical topography gave Lacaze-Duthiers access to memories of his family and youth.[60]

The house looked out onto a terraced gardens, full of birds and insects, rare flowers and fruit trees. The large avenue leading up to the house served as the path by which the village workers went out to the fields in the morning and returned at night. It was also in his garden that the annual country festival was held, adding to the pastoral enticement of the place. The daily rounds of work and the seasonal cycles began and ended in his domain. Lacaze-Duthiers's interest in Las Fons was not, as it was at Roscoff and Banyuls, that of a thrifty estate manager. Rather it served for him as "a place of peace, where we have a refuge from care, a harbor from our troubles, a calm rest-house, somewhere to work in solitude."[61]

According to Pruvot, Las Fons was a singular habitation which, like its proprietor, was full of contradictions. With its entry hidden behind the corner of the cemetery of the hamlet's church, it had a pointed tower and a large staircase which occupied almost a third of the house. In ascending its steps, one had to watch out to avoid a stove pipe suspended by a steel wire which entered through a window. Old armoires stood beside shelves which seemed to be made of old wooden packing cases. In order to enter the salon, which was comfortably furnished, it was necessary to pass obliquely through a vestibule lined with shelves loaded to breaking with dusty papers. In the attic, which was illuminated by two dormers, Lacaze-Duthiers had his personal laboratory, filled "incoherent furniture, strewn

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[60] On Bachelard see Edward Casey, *The Fate of Place* (Berkeley: University of California Press, 1998), p. 292; Lacaze-Duthiers dedicated his earliest work to his mother, writing, "dans ces heures de bonheur que m'a fait goûter tant de fois la contemplation de la nature, dans ces moments heureux où l'honne renaît à lui-même en retrouvant le calme jusqu'au milieu des vicissitudes et des ennuis de la vie, j'ai toujours eu une pensée pour toi, une pensée de rconnaissance, *Histoire Naturelle du Corail* (Paris: J. B. Baillière, 1864).

[61] Petrarch Ep. Fam. XVII.

with bottles and flasks, and disparate objects brought back from his voyages."[62] Following Bachelard, we might call this attic space a "rational zone of the intellectualized projects."[63] In the diurnal/nocturnal disparity which structures the house, it is the attic where the day's experience take shape.[64] Lacaze-Duthiers had spent his days in mastering the time, place, and conditions of observation; in his attic were artifacts and scattered traces of the things such mastery held in store.

It was at Banyuls where Lacaze-Duthiers elected to "sleep his final sleep."[65] Pruvot wrote in his remembrance of Lacaze-Duthiers that his greatest joy was to walk about his station and think of all the improvements he had realized. It was Lacaze-Duthiers's wish, Liard explained, to find his solitary repose in the "enclosure of the laboratory which was his work of preference."[66] On May 8, 1902 an official procession took Lacaze-Duthiers's casket through Banyuls; his body lay in state inside a room of the laboratory which had been made over into a chapel. The following morning it was decided that the eulogies would be read in the aquarium due to the bad weather (fig. 6.1). Circumstances intervened even in the commission of this sacred rite. Finally, Lacaze-Duthiers was buried in a crypt cut into the rock of a commanding bluff overlooking the Mediterranean.[67] In the plan of Banyuls published in Kofoid's report, the tomb is nonchalantly added to the key which designates the use the station's various out-buildings. A fence and modest tomb were built, the tombstone marked with an inscription, in gold letters (of the sort Lacaze-Duthiers would

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[62] Pruvot, "Henri de Lacaze-Duthiers," p. 27.

[63] Gaston Bachelard, *The Poetics of Space*, trans. M. Jolas (New York: Orion, 1964), p. 18

[64] Ibid., p. 19.

[65] Pruvot, "Henri de Lacaze-Duthiers," p. 49.

[66] Ibid., p. 57.

[67] Ibid., p. 47.

not allow to adorn his station): "Henri de Lacaze-Duthiers, fondateur du laboratoire Arago."[68]

[68] Ibid., p. 62.

Chapter VII

THE PHOTOGRAPHIC CAST

> Si l'on plonge dans la mer, à une certaine profondeur on perd bientôt la lumière; on entre dans un crépuscule où persiste une seule couleur, un rouge sinistre; puis cela même disparaît et la nuit complète se fait. C'est l'obscurité absolue, sauf peut-être des accidents de phosphorescence effrayante—Jules Michelet, *La Mer*[1]

This chapter examines a series of speculative enterprises which penetrate the surface of the sea and visually plumb its depths. Though the sea was recognized to have the richest (deepest) deposit of imagery, there were important blockages to its being properly seen. In addressing the question of vision and the sea, it will be necessary to abandon the customary terrestrial perspective and chart the fate of vision physiologically, philosophically, and aesthetically when the seemingly impenetrable barrier of the sea's surface was crossed and

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[1] Michelet, *La Mer*, p. 44.

the darkness which lurked in its depths was confronted. In a seeming paradox, photography emerged as the privileged means to produce souvenirs of this unlivable—and for the most part inaccessible—space. Photographic plates were used initially to measure whether vision was even possible in such a context. But with the introduction of the camera into the sea, the depths were transformed, at least in the space of the photograph, into a landscape through which the eye could roam. A reorientation in thought and in space was first necessary, however, for the sea to become such a place of visual liberty.

In his study of how a certain blindness as well as fear was built into the appreciation of a natural landscape, Alain Corbin has named the incomprehensible vastness of the earth's oceans "the territory of the void." The interpretation of biblical and classical sources provides material for its "reading" as an emotionally charged system, a place of "unfathomable mysteries, an uncharted liquid mass." [2] Yet the focus of his study is not the sea as such but the shore, the strand, ports, harbors, and finally the beach; for it was at the sea's edge that these apprehensions developed into a range of pleasures. The emergence of these sensibilities in the mid-eighteenth-century was synonymous with an effort to tame the shore by making it first an object of knowledge and then one of enjoyment. Here we will begin by charting a narrative incursion into the void; our chosen vehicle will allow us to scan its depths and to examine the meeting (and limits) of image and of text amid this fluid repository of things most strange.

Let us first reassess the legibility of this "uncharted liquid mass" by looking at one well-known illustration of it. I refer here to the "Ocean Chart" from Lewis Carroll's ballad, *The Hunting of the Snark* (1874). The chart is formed of a simple rectangle, its enclosed white surface hallucinatory in the absence of any figuration. The frame is bordered by words

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[2] Alain Corbin, *The Lure of the Sea*, trans. Jocelyn Phelps (Berkeley: University of California Press, 1994), p. 1.

designating projection lines and terrestrial division, which correspond to nothing inside the frame and are themselves mis-ordered. The Tropics, Zones, and Equators, explains the Captain "are merely conventional signs!" Indeed, this is not a chart in any conventional sense:

> "Other maps are such shapes, with their islands and capes!
> But we've got our brave Captain to thank."
> (So the crew would protest) "that he's brought us the best—
> A perfect and absolute blank!"[3]

The chart is a representation of being utterly out of place; and the crew was very much pleased, the ballad goes, finding it something "they could all understand." Yet on this chart the ocean is not seen as a troubling void, but rather has been voided of the mass of meanings which ride below its surface, sometimes troubling it but sometimes not. With land nowhere in sight, the sea loses its shape and becomes merely (and entirely) a form of experience; Carroll's chart is the log on which to plot a journey between non-places and non-sense.

We can, of course, add important additional examples from the nineteenth century which offer accounts of the history, the science, and the history of science of the seascape.[4] Literature, too, is awash in descriptions of the sea and seafaring as significant forms of experience. Indeed, Hans Blumenberg has argued that the experience of shipwreck and the position of the spectator along shore are essential and enduring metaphors adopted to describe existence.[5] But these subject positions and modes of being must ultimately be

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[3] Lewis Carroll, *The Hunting of the Snark* (Los Altos, California: William Kaufmann, Inc, 1981), p. 29.

[4] I adopt this formulation from Michel Serres's description of Jules Michelet's *Le Mer*, see "Michelet: The Soup," in Josué Harari, David Bell, eds., *Hermes, Literature, Science, Philosophy* (Baltimore: Johns Hopkins Press, 1982), p. 29.

[5] Hans Blumenberg, *Shipwreck with Spectator*, trans. Steven Rendall (Cambrige: MIT Press, 1997).

reconfigured if the world that lies beneath the sea's surface is ever to be properly read. The sea, seen from the shore, as it is presented in Michelet's *La Mer* (1861), is a "world of shadows." The ancient notion resurfaces in his writing of an "abyss," the bottom of which—if one existed—is blackness. It is a space of disappearance and loss. In its depths, as on the perfectly rendered white plain of Carroll's "Ocean Chart," things lose their visual bearing. This paper will track the progress of a shadowy figure which inhabits the depths, one which is initially known by the unnatural light it casts into these nether regions. To be more precise, a fictional ship which reordered the possibilities of perception by moving beneath the sea's surface.

Notably, Jules Verne inserts the first of the two charts which serve as illustrations for his extraordinary voyage, *20,000 Leagues Beneath the Sea* (1871), in the chapter entitled "The Black Stream."[6] This "Black Stream" referred to an ocean current which ran through the sea like a river on land, with its own distinct color and temperature. By contrast to the "Ocean Chart," the cartographic conventions of parallels and meridians are restored, as are the continental land masses. A dotted line indicates a ship's course through the blank space that we understand to be the sea. But it is not a port, harbor, or shore which provides the ship's heading. The protagonist, Professor Arronax, points to the vessel's position on the map and recognizes that it is traveling along one such current, a fluid stream within a liquid mass. Appropriately, the motto of the infamous vessel on which he is a passenger, the *Nautilus*, is *Mobilis in Mobile*, mobile in a mobile element. The movement of the submarine, like the narrative trajectory of the novel, flows likes a distinct channel through what might appears on the surface to be an undifferentiated sea. In this introductory section, *20,000 Leagues Beneath the Sea* will be regarded as a foundational text for the project of charting the

[6] All references are to Jules Verne, *Vingt Mille Lieues sous les Mers* (Paris: Bibliothèque d'Éducation et de Récréation [1871]). All translations are by the author.

landscape of the sea, insofar as it highlights the manner in which words become attached to visions and meanings of a world which was experienced in fiction before in fact. The *Nautilus*, whose own identity crosses conventional boundaries of the real and the known, serves as a means of access to the territory of the void.

THE SHIFTING REEF

"The year 1866 was marked by a strange event, an unexplained and unexplainable phenomenon which no doubt no one has forgotten." With these words, the protagonist, M. Arronax, sets the scene even as he reminds the reader of the chronic faultiness of description. Arronax, assistant professor at Muséum d'Histoire Naturelle, Paris, and author of the well-regarded *Mysteries of the Great Ocean Depths* (as well as the student of Henri Milne-Edwards), would seem highly qualified to come to terms with the troubling phenomenon; however, his report conveys a basic ambiguity as to its very nature. "For some time now several ships have met at sea 'an enormous thing,' a long fusiform object which was sometimes phosphorescent, and which was infinitely larger and more rapid than a whale." Arronax advances our understanding little, except to suggest that the phenomenon is related to a 'thing' of some sort or another.

Arronax goes on to inventory the incommensurate reports of sightings and the disputes, both in scholarly journals, and in the popular press, concerning what the thing is and, more importantly, what to name it.

> Thus broke out the interminable polemic of the credulous and the incredulous . . . Clever writers, parodying a saying of Linnaeus which had been quoted by the adversaries of the monster, held in effect that 'nature does not make fools,' and admonished their contemporaries not to contradict nature by admitting the existence

of Krakens, sea serpents, 'Moby Dicks' and other lucubrations of delirious sailors (3–4).[7]

In this passage we hear, with the help of Arronax's keen ear, how the newspapers interpreted the scattered signs and traces left by the 'object' as confirmation of apocryphal accounts of monsters which literature and lore had made both fearsome and irresistible. Indeed, this riot of reports is complimentary to the opening sections of *Moby-Dick*, the "Etymology" and "Extracts" in which the leviathanic volume is reduced to its sources in language, its very name connected to the act of rolling. Arronax's passage exposes several possibilities of seeing and saying, which include states of delirium, the perforation of the self-enclosed language of aphorism, as well as dark acts of lucubration. Yet the object upon which all this linguistic ingenuity has been trained was still evolving before the speakers' eyes.

Yet Arronax, dismayed that "wit has overcome the spirit of science," seeks to determine the true nature of the thing by referring to those scientists who, like himself, make a method of comparing the unknown to the well-known. The very force of their authority would ostensibly put the debate to rest. In a characteristic extra-textural reference, to a list of great naturalists, Arronax declares: "neither Cuvier, Lacépède, Duméril nor Quatrefages would not have admitted the existence of such a monster—unless they had seen it, that is, seen it with their own eyes of a savant" (2). Seeing, or having something before one's eyes, was the essential corrective to the potentially misleading knowledge offered by texts. As Melville warned in the section of *Moby-Dick* "Of Monstrous Pictures of Whales," these same authors were, in fact, guilty of the "heinousness of mistake" which followed from describing

[7] Here Verne makes a pun on the French "saut" ("jump") of Linnaeus's "nature does not makes jumps," which means that there is a continuum of natural kinds, and "sot' ("fool").

things without actually having seen them.[8] Though conceived in a conscientious effort, these monstrous images were composites of fact and fiction. The crux of the dilemma for the interlocutors drawing on the available vocabulary of naturalists, however, was that this elusive, unnamable 'thing' was not of nature at all, but an artifact—namely, Captain Nemo's submarine the *Nautilus*.

Once this fact is known, there is no longer any risk of "contradicting nature." When Arronax has seen the *Nautilus* with his own eyes, the ship ceases to be the object of speculation and rather becomes the site of contradictory forms of experience which it mediates. The *Nautilus* becomes a new optic with which to view the obscure milieu which has hidden its very nature. As the narrative develops, the surrounding sea is seen by Arronax from within the vessel's confines.

The title of the first chapter, "A Shifting Reef," suggests a topographic feature—neither land nor water—which cannot be fixed upon a map and threatens safe passage. Verne's novel, interweaving fantasy with science, history, and literature, is itself a shifting reef of fact and fiction, the known and the unknowable.[9] The elliptical language of its opening chapter ultimately gives shape to something more difficult to describe and comprehend than a white whale or Kraken; specifically, the instruments used to observe phenomena, be they natural or of man's making. If by instruments we tend to mean tools crafted to translate the real, then the fictional *Nautilus* is certainly one for encountering the undersea world. The *Nautilus*'s most striking mechanism—and part of what makes it such a compelling literary vehicle—is its "window opened to an unexplored abyss." How does the narrator come to view this unprecedented undersea panorama? Or perhaps more

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[8] Herman Melville, *Moby-Dick* [1851] (New York: W. W. Norton, 1967), p. 226.

importantly, how is this window constructed and what kind of spaces does it mutually separate and visually connect? As to the first question, Arronax was aboard the American frigate *Abraham Lincoln*, which was dispatched to rid the seas of the menace, presumed by the naturalist to be an unusually large whale. Suddenly, however, the creature seemed to disappear and there were no sightings at all for two months. Had the creature intercepted a telegram transmitted over a transatlantic cable, making use of the information it conveyed to conceal itself? This thing was possibly all the more sinister for possessing in own strategy of invisibility. It was a case of an entity in the order of things which knowingly defied attempts to be known by assessing what was already known about it..

The immediate consequence of Arronax's search for answers was that he was deprived of vision. Fending off its pursuers, the monster rammed the *Abraham Lincoln*, casting Arronax, his assistant Conseil (literally "advice"), and the Canadian harpooner Ned Land overboard. Having lost sight of their ship during the night, and with it the hope of being rescued, they washed up on the "shifting reef," the steel topside of what they discover is a submarine. Anxiously awaiting a sign of "hospitality," they are finally whisked "at the speed of lightening" into a completely dark chamber. At first, they grope blindly to gain a sense of the extent and contents of their prison. Arronax surveys the room with his arms outstretched before him, toppling the furniture in his path. Ned, his knife drawn, is ready to stab anything that approaches him in the darkness. The floor of the room is covered with a thick linen which muffled the noise of their steps. No trace can be found of a door or window. Theirs is an experience of pure interiority: Arronax and his companions are deprived of sight and sound; their transit into Nemo's world is experienced as a black-out.

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[9] Roland Barthes writes in this regard, "the basic activity in Jules Verne, then, is unquestionably that of appropriation, "The Nautilus and the Drunken Boat," in *Mythologies* [1957], trans. Annette Lavers (New York: Hill and Wang, 1972), p. 66.

The interlude in the ship's dungeon animates both their curiosity and their indignation, but it also marks a threshold into a new order of experience for which neither memory nor custom could have prepared them.

The restoration of their vision comes with the arrival of Nemo, who invites them to inspect the ship in which they are now held captive. By keeping them, Nemo guards not them but himself; they have come upon a secret which no one in the world may know. For Arronax at least, knowledge of the ship—and yielded by the ship—is tantamount to the completion of his work as a naturalist which began at the museum. Nemo explains that the professor's work on the ocean depths was among his favorite books, but its limits were soon to be overcome. "You have pushed your knowledge as far as earthbound science will permit. But you do not know everything; you have not seen everything" (70). The first new thing the naturalist is offered to inspect is the ship itself. In the chapter "Some Figures," a veritable litany of vital statistics, the captain gives full measure of the size and capacity of the vessel; a vessel which so far has exhausted the reserves of language of those who tried to limn it from the traces it scattered on the sea's surface. Nemo not only informs Arronax about every aspect of the vessel, but discloses the "secret" of its construction. Every part was sent from a different part of the globe to "a disguised address." The manufactures each received plans under different names. The very construction of this narrative vehicle constituted a conspiratorial plot: the parts were assembled on a desert island, after which a fire destroyed "all vestiges" of the construction crew's stay there. Nemo is literally at home in this assembly of purposefully mis-addressed elements; the ship's motto was engraved on the captain's table settings. Even his name is an echo of an active disguise: Latin for "no man," Nemo, like Odysseus in the cave of the Cyclops, is a clever outwitter whose very name renders him invisible and untouchable.

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The professor is then shown the suite of rooms furnished with the captain's extensive library of works in every language and every topic except politics and economy—Nemo had cut himself off from the affairs of the terrestrial nations, the commerce of which his ship threatened. Arronax is astounded that such a library should travel with the captain into the depths. "Where could one find greater solitude or silence, Professor," asks Nemo. Can you boast of greater tranquillity in your office in the museum?" To these spaces are connected a painting gallery and a curiosity cabinet befitting a palace on dry land. But the marvelous library and the collections which the *Nautilus* carried into the depths were but a prelude to the opening of its encapsulated interior to those depths. As Ned and Conseil joined Arronax in the vessel's richly appointed lounge, the lights suddenly went out, again plunging them into complete darkness. The sound of sliding panels was heard, and suddenly light entered the room from two oblong openings. They saw the sea brilliantly lit by the electric light emitted by the vessel itself; the *Nautilus* was the source of illumination for the undersea world. Arronax describes his first impression of these windows, the vessel's eyes, in terms which quickly turn from the sublime to the reassurance of calculation: "Two plates of crystal separated us from the sea. At first I trembled at the thought that this fragile partition would shatter; but the strong copper framework held it in place, and gave to it an almost infinite resistance" (103). The structure of the *Nautilus* literally resolves itself in its great lens.

Verne stages a dialogue before this composite lens, in which Arronax, Conseil, and Ned Land employ different terms for describing the equally diverse nature of things they glimpse outside. Ultimately, language is as necessary an accessory to the lens's seeming transparency as the frame which reassuringly holds it in place. "You wanted to see something, and now you've got it," Conseil says as he and Ned look through the glass with astonishment. But in response to Ned's complaint that he could not at first see any fish, the assistant-naturalist chastises him, "what difference does it make to you, my friend, since you couldn't recognize them anyway" (106). For Conseil, to recognize means to make distinctions, to classify. Thus he begins to elaborate for the able harpooner the two major groups of fish, continuing on to finer gradations. Yet Ned has his own method of classifying fish: those you can eat and those you can not. For each sub-division of fish Conseil points out with its characteristic anatomy, Ned offers sauces with which they are cooked. While both of them define groups, Ned has a gastronomic and Conseil a seemingly scientific understanding of their composition. As Arronax explains, while classification was "his whole life," Conseil was not a naturalist as such; he is well versed in the ranks and orders, having picked up terms second-hand which he overheard during his rambles through the Museum's collections. Ned, with his sensitivity to the traits of fish sharpened by practical necessity can properly name any individual but is gleefully ignorant of their taxonomic rank. Arronax gives expression to a third, synthetic manner of seeing and speaking. "Ned named the fish, Conseil classed them, me, I went into raptures before the vivacity of their allure and the beauty of their form" (109).

Arronax coalesces the distinct perceptions of the classifier and fisherman in his own manner of speaking. He sees freely what is alternately shuttered or indistinct to Ned and Conseil. Arronax's remarkable description of a meal at captain Nemo's table exemplifies this well:

> It was made up of various fish and slices of sea cucumber seasoned with very appetizing varieties of seaweed, such as *Porphyria laciniata* and *Laurentia primafetida.* The drink consisted of a liquid of limpid water to which, following the captain's example, I added several drops of a fermented liqueur extracted, according to the Kamchatkian method, from an alga called *Rhodomenia palmata.* (115).

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Arronax unselfconsciously mixes vocabularies, using the Linnaean binomial to describe a savory seasoning while adducing a proto-anthropological recipe of his beverage. Arronax's description is all the more remarkable as the *Nautilus*'s dining room is ensconced in the very element from which the flora and fauna upon his plate are taken. Verne relies on Arronax's insight as a reliable means of narrating the unreal scenes which unfold in the *Nautilus*'s wake.

Arronax's rapture at the charming scene before the glass, experienced only after the terrifying threat of its fracture had been overcome, is, in essence, aesthetic. He admires the allure and formal beauty of the objects without consciously having 'recognized' them. Through his state of rapture, or transport, he is placed in contact with things, but only through the intermediary of the glass. Arronax can look through the glass only after looking *at* the glass, calculating the resistance of its chassis and touring the rooms to which it is adjacent and which constitute its frame of internal reference: the library, the gallery, the study. When Arronax looks through the window, he sees a reflection of his own status as an observer. "We looked out as if this clear crystal were the window of an immense aquarium" (103). Indeed, it was a picture window onto a *tableau vivante*. The comparison acknowledges that the *Nautilus* is a perceptual container beyond whose confines the fish are "as free as birds in the air." In fact, the window is two-faced, one side protecting its passengers from the surrounding milieu, the other giving them unprecedented access to it.

Allan Sekula has remarked on the curiously contained and aquarium-like appearance of the panoramic underwater space which is suggested by the novel's frontispiece. Submarine space, he argues, was initially imaged to be amenable to the geographically encompassing form of the panoramic representation. The image is split between the sea's surface and ocean depths, intersected by the sounding body of a whale. "In the pictorial imagination, the undersea world offers a verticalization of a panoramic space, a submerged neo-gothic ninety-degree reorientation of the floating eye."[10] Indeed, this manner of depiction has important precedents in the illustrations accompanying encyclopedic works such as Duhamel du Monceau's *Traité Général des Pesches et Histoire des Poissons*.[11] The water line which divides the picture plane in half allows the reader to cross the "impenetrable barrier" of the sea's surface which made it foreign even to the fishermen who derive their livelihood from it. The point here, however, is not to examine the novel's illustrations. To be sure, they are not merely subordinate to the text but extend its imaginary realm. But it is the experience of standing outside an unfolding scene, not a static representation of it, which the reference to the aquarium evokes. Having discussed the discussion which took place before the glass, let us thus look at the adventures of Arronax and his party outside of the *Nautilus*'s self-referential enclosure.

In the scenes in which Arronax and his companions are invited to explore the underwater landscape, the vessel itself can be seen as the objective correlative for the cultural apparatus which accompanies them as assuredly as their diving suits. The ship is the very essence of an encapsulated (encapsulating) vision. Not incidentally, their immersion into the surrounding realm follows a series of events similar to their original imprisonment. Taken into a "cell" where they don their suits, the level of water in cell slowly rises as the inside become the outside. They now are free to walk through and take possession of the underwater landscape. Yet they are at a lack of words to describe it:

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[10] Allan Sekula, *Fish Story* (Düsseldorf: Richter Verlag, 1996), p. 111.

[11] Duhamel du Monceau, *Traité Général des Pesches et Histoire des Poissons, qu'elles fournissent, tant pour la substinance des hommes, que pour plusiers autres usages qui ont rapport au arts et commerce* (Paris: Saillant & Nyon, 1769), I, p. 8. For the appearance of submarine vessels in such works, including the Nautilus designed by Robert Fulton, see Jean-Claude Pujol, "L'Intervention Sous-Marine au Temps de l'Encyclopédie," in Jean Balcou, ed., *La Mer au Siècle des Encyclopédies* (Paris: Champion-Slatkine, 1987), pp. 243–252.

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> And now, how can I recount the impressions this walk beneath the surface of the ocean left on me? Words are powerless to describe such marvels. When the painter's brush cannot even render the effects particular to this liquid element, how can the pen hope to reproduce it? (121).

His underwater promenade begins with a period of visual as well as bodily acclimatization. Arronax states repeatedly that he forgets his suit, all things having a different specific weight than they do on the land. But once he becomes accustomed to this new order of things, he is still unable to comprehend it. Neither image nor text could give a proper account of what was suddenly put before his eyes. Yet was not this the very condition of having certain knowledge of things? Indeed, in making his way through the ocean's depths, his understanding of things must some how be restored. Where before the window, amid the "bosom of [the ship's] unbroken inwardness," words flowed from each member of the party, once cast into the "exterior vagueness of the waters," all words are lost to him.

The unexpected encounter of ruins in subsequent scenes points to a human past harbored by the sea. In fact, the phantasmagoria of the underwater landscape suggests that it is precisely here that lost worlds might be found again, perhaps in the way Arcadian visions flourish in the garden tradition. Such is the case in the most dramatic of the underwater promenades Arronax is led on by Nemo. After a long and arduous hike, he is taken to a plateau where he sees picturesque ruins which, in contrast to the bizarre and luminescent animals he saw along the way, were the work of man and not the Creator. He sees vast heaps of stone which are covered not with ivy, but with a mantle of seaweed. With the entire scene lit by incandescent lava spewing forth from a nearby volcano, he makes out the remains of a town. Here he sees the remains of an aqueduct, though the water it was meant to convey now intermixes with that of the sea, no longer forming a distinct current. There lie the vestiges of a quay, as if a port once sheltered ships at some extinct shore. These passages contain numerous reversals of visual logic and of reference brought about with the submergence of the terrestrial world. The structures survive like Pompeii, but rather than being excavated, all that is required is to travel these unexplored depths. All this, Arronax exclaims, "Captain Nemo revived before my view! (297–98). But even as Nemo (re)animated the scene, something still more was required to make it comprehensible to Arronax.

The topography of the phantom city at first is a mystery. In fact, its identity as well as the profound chasm he had just crossed between fact and speculation, history and myth, must literally be inscribed for Arronax by Nemo.

> Where was I? Where was I? I had to know at any price. I wanted to speak—I wanted to tear off the copper helmet that imprisoned my head.
>
> But Captain Nemo came over and stopped me with a gesture. Then, picking up a piece of chalky stone, he went over to a rock of black basalt, where he wrote this single word:
>
> ATLANTIS
>
> What clarity shot into my mind! (298)

The word, connecting the scene to the passages from Plato's *Timaeus*, is brought back in a flash by Nemo's inscription. The imaginary past of a lost continent is revived through the word now put before the naturalist's eyes. The word Atlantis becomes magically evocative when Arronax is given access, through the brute efficacy of technology, to the objects upon which so many words and speculations have been spent. *In situ*, the imagination is free to ponder the sea change which the once great city has undergone.

Returning to the "shifting reef," we see how language is used to identify the vessel that at first travels beneath the surface of signification. It could only be known by what it is called, by the things to which it is compared in the scholarly journals and newspapers which give accounts of its sightings. Yet with Arronax, Ned, and Conseil aboard we are allowed to peer into the medium which once disguised the *Nautilus* from view. As an instrument, the submarine disturbs the very boundaries and arrangement of time and space which was seen to be overturned in the discovery of Atlantis.[12] By extending vision into a place where scientists questioned the possibility of vision even for undersea inhabitants, the ship, with is fugitive eye, ceases to figure as a camera-like instrument, and emerges instead as a particular kind of space for the accumulation of knowledge.

How does this voyage into a new world of vision end? During a great whirlpool, Arronax is cast from the ship along with his companions, losing consciousness in the event and with it his memory of how he was set free. Regaining consciousness in a fishing cottage, he is left to wonder whether Nemo still inhabits the sea. Thus, to that question posed in Ecclesiastics, "That which is far off, and exceeding deep, who can find it out?" only two men had the answer: Nemo and Arronax, one as the manufacture of a vehicle of experience, the other confined to it. Indeed, it is Nemo who must caution Arronax not to remove the helmet which imprisons his head when the wonder of the sea causes him to suffer from a fit of language. Thus this work of fiction invented a landscape which only subsequently would be mapped by scientists and others venturing into "the territory of the void." The seascape lies there, where the painter's brush and the pen still fail to capture the scene; the *Nautilus* was a powerful agent in making this obscure landscape of the sea known.

PHOTOGRAPHY

As we move from fictional to the historical discourse, the question of who or more properly what inhabited the sea visually was not neatly resolved with objective

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[12] Louis Blanquart-Évard, *La Photographie, ses origines, ses progrès, ses transformations* (Lille: Imprimerie Danel, 1870), p. 62.

demonstrations of fact. Rather, the scientific survey of the sea's depths disclosed a region which, even if it did not have the same spatial and geographic points of reference of the *Nautilus*'s voyage, required special instruments to be seen or even detected. In fact, the innovation of figural photography in the sea comes as a sort of consolation to the results of earlier, quantitative study of the transparency of the sea itself. When interpolated with studies of an almost accidental nature on the limits of photography itself, these results at once greatly extended the regions of vision but limited the place of the human eye within it. Dramatizing the strangeness of his own enterprise, Louis Boutan began his *La Photographie Sous-Marine et les Progrès de la Photographie* (1900) by comparing his situation as photographer to that of an inhabitant of the moon looking down to Earth. Indeed, as the name given to Ardan (an anagram of Nadar), the protagonist of Verne's *From the Earth to the Moon* would indicate, the effort to photograph in such an unearthly element as the sea represented a daring experiment.

They were alike in that the latter, floating in the ethereal upper regions, was likely to mistake the Earth's thick outer atmosphere for its surface below. In order to get any sense of the Earth's surface and its inhabitants, the "lunatic" was reduced to the methods naturalists had used to examine the sea; restricted to the sea's surface, they would indiscriminately drop nets, sounds, and other traps into dense mix below. Boutan compared these "primitive instruments" to the anchor dropped from a balloon with the hope of snagging onto a mooring below.[13] Perhaps the net would catch a bird, and mistake it as the Earth's principal inhabitant. Or, if a hook grappled a smokestack, it might be interpreted as the mysterious abode of an unknown animal. But just as film was becoming a site of the imagination—only two years later, the moon itself would be reached in Georges

[13] Boutan, *La Photographie Sous-Marine*, p. 141.

Meliès's "Voyage dans la Lune"—Boutan saw photography as a means of forming "clear and precise ideas" of the sea. Once pictures could be made underwater, all hypotheses and lunatic ideas would give way to indisputable facts. Or so Boutan claimed.

By that time, a long and occasionally irrational debate had raged in scientific circles over the factors which limited what Boutan would call the "photographic horizon" of the sea. Innovating in the use of photosensitive plates as metric devices, naturalists sought to determine the optical properties of sea, including color and transparency. Exposed using camera-less techniques, the luminous impressions made on these plates had comparative but no imagistic value; they simply registered the presence of light in the water. By contrast, for Boutan the sea played the "role of a screen" within the frame of the picture itself, potentially impeding the clear perception of objects. More than the use of photographic plates connected these quantitative and image-making practices, along with other types of figural photography which will be discussed below. A dark room, which shared phenomenological if not structural traits with the prison aboard the *Nautilus*, can be seen to migrate conceptually through these various projects or research. To anticipate a general conclusion, it would become clear that the presence of vision depended on having a specific receptor (be it an eye or something else) for a specific region (visible or not) of the spectrum. To examine this quandary, we will begin with an unresolved case of presumed blindness.

ON TRANSPARENCY

In 1874, the Swiss naturalist Antoine Forel reported the discovery of two species living on the bottom of Lake Geneva, matte white in color, which had no eyes. Forel's initial explanation of the animals' lack of eyes had to do with the conditions of visibility of water itself. "Ceux animaux ont subi, semble-t-il, les modifications des êtres qui ont vécu depuis longues séries de générations dans un milieu absolument obscur."[14] But in seeking to determine whether water proved an impenetrable barrier to light, he arrived at conclusions telling of the limits of human vision. Forel began by making use of a simple experiment devised by the Italian astronomer Angelo Secchi. A canvas disk painted a brilliant white was lowered into the water along a notched cable. A clear visual signpost, predictably the disk became progressively indistinct as the watery depths separating it from the observer grew. But the experiment was not definitive, serving only as an indication of how things looked from the surface. The fact that, at a given depth, the disk could not be seen through the water did not mean that light was no longer present in the water. To determine the point where light failed to penetrate altogether, the lake's "limit of absolute darkness,"[15] he had somehow to replicate the blind species' point of view.

With the aid of photographic plates, Forel changed the subject position of the experiment. A light receptor of this sort would record conditions from their very midst. The plates serves as a visual proxy in depths where it was not convenient for the naturalist to enter. Working under cover of "the black of night,"[16] he rowed to a position on the lake which he determined by aligning two points of light on the shore, and submerged the plates made with a silver nitrate emulsion to a previously established depth. The following day, he exposed an identical plate to the sun for a variety of intervals, creating a scale of tones. That evening he returned to the lake and retrieved the plates, to which he immediately applied a fixative. By comparing the two results, he assigned a number corresponding to the intensity of "luminous activity" under water. After several trials, he determined that the

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[14] François Forel, "Recherches Photographiques sur la Transparence de l'Eau," *Bulletin de la Société Vaudoise des Sciences Naturelles*, ser. 2, vol. XIII, no. 72 (Juin 1874), p. 24.

[15] François Forel, "L'Éclairage des Eaux Profondes du Lac Léman," *Association Française pour l'Avancement des Sciences* (1888) extrait, p. 2.

[16] Forel, "Recherches Photographiques sur la Transparence de l'Eau," p. 27.

sun penetrates to a depth of forty meters, but he also noted that that depth and the intensity of light itself changes with the ambient temperature and the season. In spite of this range, however, Forel insisted that there is a depth which could easily be reached where darkness finally reigns.[17] The proof was to be found in the absence of any photographic result—the ersatz eyes which failed to see.

The Société de physique et d'histoire naturelle de Genève sponsored a commission in 1883 to study the reasons for this variability, as well as the character (as opposed to the mere quantity) of this light. The commission's object of study was Lake Geneva, and "all the natural phenomena for which it is the theater."[18] In his study of the color of water, J. L. Soret wrote of the impossibility of creating an "optical void milieu," one which absolutely limpid and free of heterogeneous particles.[19] The quantity, distribution, and movement of these particles changed according to the time of day and season of the year, and the optical properties of the water varied as a result. The blue cast of water was itself the result of suspended organic matter which intercepted direct rays of light "in the manner of a screen."[20] It is legitimate to suspect that, given the empirical tradition of the Genevan school of natural history, dating to Jean Senebier, author of *L'Art d'Observer*, the specter of opacity was something of which careful account needed to be taken. Having eliminated the possibility of an absolutely limpid optical milieu, the threat was present that the conditions in which a phenomenon could be observed could also become those which hid it from view.

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[17] Ibid., p. 32.

[18] Hermann Fol, Édouard Sarasin, "Pénétration de la Lumière du Jour dans les Eaux du Lac de Genève et dans Celles de la Méditerranée," *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, t. XXIX, no. 13 (1887).

[19] J. L. Soret, "Sur la Couleur de l'Eau," *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, t. XXIX, no. 10 (1887), p. 8.

[20] J. L. Soret, "Commission pour l'Étude de la Transparence du Lac," *Archives des Sciences Physiques et Naturelles*, ser. 3., t. 12 (15 Août 1884), p. 161.

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Curiosity about the trailing edge of visibility in the dense milieu of water was not, however, a local phenomenon. After working with Forel in Lake Geneva, Hermann Fol carried out a renewed series of experiments using the then-new Monkhoven plates in Swiss lakes as well as in the Mediterranean. Offering twice as much sensitivity as the plates used by Forel, Fol noted that even the darkest night was enough to expose the gelatino-bromide emulsion.[21] Thus great care was required in moving between what he identified as "the dark room" and the "place of experiment."[22] Nominally, the dark room was where the plates were prepared; the place of experiment was where they were exposed. However, the necessity of working under cover of the night's darkness, as Forel had done, was removed by Fol's design of a precision chassis to hold the plates (fig. 7.1). In his first design, a shutter was operated either when a sound hit the bottom or by the tension of the cable when the plates tethered along its length reached a designated depth. In a later model, a clockwork mechanism drove a rotary shutter, which allowed Fol to make exposures automatically for fixed intervals of time at different times of day. Once the plates were retrieved from the place of experiment—the water—they were taken immediately to a dark room set up on the same ship from which the lines were cast. Fol's conclusions did not differ from those of Forel, except the depth to which light was reported to penetrate doubled, a result directly predicted by the increased sensitivity of the plates.

Research into the transparency of water was cast into doubt by the question of the sensitivity of the receptors used in the experiment. The reasoning which neatly equated what the plates recorded and what the human eye or species of the depths could see was similarly called into question. An anomaly in the field of astronomical photography revealed that such plates were unsure indicators of the range of vision itself. In an article

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[21] Ibid., p. 8.

"Sur la Comparaison des Résultats de l'Observation Astronomique Directe avec ceux de l'Inscription Photographique" (1886), the astronomer Max Wolf reported that certain nebulae which could be seen by the eye failed to make an impression on photographic plates, and vice versa.[23] The potential significance of his observation was quickly appreciated by Georges Pouchet, who responded in "On Stellar Photographs and the Blind Animals of the Deep." Pouchet interpreted the discrepancy as a challenge to the assumption that, because photographic plates do not register light after a certain depth, the animals living in those depths must be blind. He pointed out the "black room" in which Monkhoven plates are prepared, noting that the clearly visible red light in which the fabricators prepared the plates had no effect on the plates. He drew the obvious conclusion: the retina is effected by rays of light to which the plates are insensitive. This was exactly the kind of light which could be detected by animals living in the "so-called obscurity of the depths." Red light was the least refringent of the visible spectrum and was the most likely to pass through the watery masses. Seemingly blind deep-sea organisms could very well visually occupy this portion of the spectrum.

Photography entered into the debate at this point as a means of sorting out the visible from the invisible. The physiologist Raphael Dubois, who was the first to explain the chemical processes of the mysterious phenomenon of bioluminescence, suggested the depths were illuminated by this source of living light. Pouchet was not yet convinced of this fact, arguing that only those who believed in the absolute darkness of water held that this type of light was a vehicle for vision. He explained that Forel's species lacked eyes not because of the obscurity of the lake, but because they lived in unknown caves beneath its floor. The

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[22] Ibid., p. 6.

[23] Max Wolf, "Sur la Comparaison des Résultats de l'Observation Astronomique Directe avec ceux de l'Inscription Photographique," *Comptes Rendus des séances de l'Académie des*

very question of transparency, then, was an artifact of the blind process by which specimens were dredged from the depths without any knowledge of where or how they lived. But Dubois not only insisted upon the importance of living light, but researched the possibility that the eye was not the only organ for sensing light. Dubois recognized that photography was an exemplary means to capture the "cold" light produced by enzymatic reaction. The twenty-three hour exposure time required for the lamps to expose the images was a clear demonstration that the type of chemical radiation which made an impression on the plate was feeble in comparison to luminous radiation readily visible to the eye. Dubois described the process as "photography of the invisible" which captured the light emanating from luminescent organisms which was invisible to the eye.

The photography of the invisible propelled Dubois into a curious debate with the physicist of notorious views, Gustave Le Bon, over his notion of "black light," or light which made a photographic impression without being visible to the eye. Dubois found the phenomenon reported by Le Bon—the trace left on a photographic plate by a fish—to be the cumulative radiant action of invisible bacteria which lived on its decaying skin. Though it is beyond the scope of our study, suffice it to say that Le Bon's dubious research on radiation was part of an anti-rationalist account of the divide between the material and the immaterial worlds. In *Quand j'étais Photographe*, Nadar, too, reports of an ambitious young man who visited him with reports of being able to photograph things which the camera did not see. There was an epidemic of impressionability in the air for which—in this case—photography was the chosen filter. Georges Didi-Huberman has discussed how photography was summonsed as a means of testing the presence of ethereal entities and so-called acronymic rays. Photography played a pivotal role in the question of rationality

Sciences t CII (1 Mars 1886), p. 477.

itself, its ability to detect what the eye could not see—a peculiarity not of a solely physicochemical nature, "since it raises the whole problem of the constitution of knowledge through the instrument of sight.[24]

While Dubois engaged these debates, his wider intentions can be read in the very iconography of the photographs made with his living-lamps (figs. 7.2–3). A marble bust of Claude Bernard, the progenitor of the concept of the interior milieu, is bathed in the "living light." Dubois proposed a far-reaching theory of physical, motor, and trophic photo-reactions by virtue of which organisms respond to and act in concert with the luminous perturbations of their environment. These include the "chromatic functions," or mimeticism, which cause an organism and its environment to become indistinguishable. While the place of mimicry in twentieth-century theories of vision warrants discussion, suffice it to mention here Eugène Minkowski's notion of "dark space," which fills all things and which destroys distinctions between inside and outside.[25] However, Dubois had in mind a very specific black room as an example of the luminous milieu. Notably, he commented on reports that, after spending an entire day beneath red lights, the workers in Lumière's factory began to gesticulate wildly and to pester women. As it turned out, the light was having a physiological effect far beyond the retina.

The order of response that interested Dubois differed from the essentially visual mechanisms by which Fol and others showed certain species literally to clothe themselves in elements taken from their immediate milieu. For Dubois, the eye was not the chief or even a necessary organ for detecting light. Rather, he sought to understand the relation between the

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[24] Georges Didi-Huberman, "Photography, scientific and pseudo-scientific," in Jean-Claude Lemagny, André Rouillé, eds., Janet Lloyd trans., *A History of Photography* (Cambridge: Cambridge University Press, 1986), pp. 71 [71–75].

[25] Eugène Minkowski, "Le temps vécu," *Etudes Phénoménologiques et Psychologiques* (Paris 1933).

production of light by an organism and its capacity for "dermato-optic response," or light sensitivity through the skin. In an 1889 study of the Pholas, a bottom-dwelling mollusk, Dubois wrote: "[T]andis que le phénomène photodermatique est provoqué par des vibrations lumineuses venues du dehors, le phénomène photogénique a pour résultat final l'émission de radiations lumineuses dans le milieu ambiant."[26] Dubois produced a very particular sort of camera to analyze the Pholas's response to ambient light. A sample tissue from the Pholas's siphon was put inside a dark chamber, the temperature of which was kept constant by a gas flame. A metronome electronically synchronized a shutter which admitted light into the chamber for fixed intervals. The electro-chemical periodic response of the siphon to these pulses of light was fed through a Marey amplifier; the latter produced a signal connected to a stylus which plotted a "graph" on a rotating cylinder. Dubois wrote, "by means of this special device it is easy to obtain graphic curves of the superficial or reflex motor photo-reactions . . . In these conditions, it is exactly as if one registered the contractions of the rods and cones under the influence of light upon the retina."[27] Coupled to the read-out mechanism, the Pholas inscribed its own sensation to light. Dubois went on to test the Pholas's selectivity, subjecting it to waves of light from across the spectrum; the organism thus become a "photometric machine."[28] (Recognizing the significance of such experiments, Lumière, Dubois reported, later changed the light in his factory to green, with a soothing effect on the workers.)

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[26] Raphaël Dubois, "Sur le Mécanisme des Fonctions Photodermatique et Photogénique, dans le Siphon du Pholas dactylus," *Comptes Rendus des séances de l'Académie des Sciences* t. 109, # 6 (5 Août 1889), p. 235.

[27] Raphael Dubois, *La Vie et Lumière* (Paris: Librairie Félix Alcan, 1914).

[28] The expression comes from Jacques Loeb, *The Mechanistic Conception of Life* (Cambridge: Harvard University Press, 1964), p. 41.

Chapter VII

Though the Genevan photometric experiments were carried out with photographic plates, their results took the form of numeric tables or tonal scales. Similarly, Dubois's device registered "graphical," non-mimetic readouts of the specimen's photo-reactions. Boutan took the more naive approach of placing a camera of traditional design into the sea. Using diving equipment, Boutan went into the sea, at first in order to carry out direct observation of living specimens, and after as a camera operator. This approach resulted in an important reorientation of the view of the sea. While Boutan was concerned with the level of light in the depths, by placing his camera in a horizontal position relative to the sea floor, the panoramic depths of the sea entered the frame. For this reason, Boutan criticized the camera designed by the oceanographer Paul Regnard which could only take pictures from above, producing a plan view as if seen from a balloon.[29] But alongside Boutan's efforts to place the camera into the sea were efforts to place the camera in front of it, which is to say in front of the glass window of a marine aquarium. Working at the marine observatory of Concarneau, the photographer Paul-Louis Fabre-Domergue perfected a system of photographing this at once representative and representational underwater space. In doing so, he had to construct the relation between figure and ground of a fluid visual milieu.

The photography of Boutan and Fabre-Domergue at once falls short of and greatly surpasses the order of information and legibility of the documentary photograph. The slide projections used by Alphone Milne-Edwards during his lectures at the museum, Fabre-Domergue wrote, were a perfect demonstration of the effectiveness of photography as an illustrative tool. A generation earlier, Milne-Edwards's father, Henri, impressed his students with the sketches he rapidly made on the blackboard. Though he had a deft hand,

[29] Louis Boutan, "L'Instantané dans la Photographie Sous-Marine," *AZEG* ser. 3, t. 6 (1898), p. 299.

Milne-Edwards greatly encouraged the use of photography as a research tool. In an influential 1853 report on Louis Rousseau and Achille Devaria's heliographic engravings of the Bisson brothers' immaculate collodion prints, he explained:

> [U]ne image photographique bien faite donne, non-seulement ce que l'auteur a lui-même vu et voulu représenter, mais tout ce qui est réelement visible dans l'objet ainsi reproduit. Un autre naturaliste pourra donc y saisir des faits que le premier n'aura pas aperçus, et faire réellement des découvertes à l'aide de l'image, comme il en aurait fait en observant l'objet en nature.[30]

Not only did such a process promise to make photographic images more widely available, but the image served as a sort of index to which one or numerous naturalists could make continued reference as the scope of their respective research changed. Fabre-Domergue did not see his images primarily as preparatory studies, having taken great care to master the pictorial conventions of his views. The images are highly composed in a manner which results from continued study of a compositional problem. Boutan's images result from an opposite set of conditions, the fact that it was impossible to make sketches or preliminary studies when working in the water itself. His image result from meticulous preparation for the moment of the photograph coupled to the unforseeable arrangement of objects which would actually fill the camera's field of vision.

Fabre-Domergue's images do not qualify as underwater photography. He placed his camera in front of the aquarium, the interior of which he had carefully modeled after nature. While it was easy to take photographs of terrestrial animals, and increasingly so of celestial

[30] Henri Milne-Edwards, "Rapport sur un Ouvrage Inédit, Intitulé: Photographie Zoologique, par MM. Rousseau et Dévéria, Institut de France, Académie des Sciences," *CRAS* t. XXXVI (June 6, 1853), p. 993.

bodies, marine organisms were rarely observed "à l'état de vie et dans leur milieu naturel."[31] His innovation lay in constructing the photographic field of the aquarium (fig. 7.4–5). Rocks, algae, and gravel were thus arranged in the aquarium "au goût de l'opérateur." Like the painter of a historic tableau creating the proper entourage, the goal was to create "un paysage approprié aux mœurs de chaque espèce."[32] Living specimens were placed in the aquarium at least twelve hours before they were to be photographed to gave them time to become accustomed to their "new home."[33] The subjects, or "prisoners" as he called them, inhabited the photographic scene in the same way Nemo's captives lived within a mechanism of viewing. As a result, Boutan noted, while Fabre-Domergue's images were highly illustrative, they could not replace images taken "en pleine liberté."[34] While the aquarium kept Fabre-Domergue's specimens alive, they were nonetheless displaced from the biological context from which they evolved.

In spite of this criticism, Fabre-Domergue's aquarium was a unique sort of photographic space which incorporated into its structure elements of the seascape which Boutan himself would have great difficulty in mastering. The front and back of the aquarium served respectively as picture plane and background. The picture plane had to be of a "rigorous" transparency, which was difficult to maintain due to the algae growing inside of the aquarium—put there for the sake of verisimilitude. Thus the aquarium was emptied and scrubbed between shots; it came to life, as it were, only during the space of the photo-session. The back surface, by contrast, was furnished with "un écran peint en gris

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[31] Paul-Louis Fabre-Domergue, *La Photographie des Animaux Aquatiques* (Paris: Georges Carré et C. Naud, 1899), p. 1

[32] Ibid., p. 2.

[33] Ibid., p. 2.

[34] Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 305.

formant le fond du paysage."[35] This screen, the tonality of which could be altered according to the nature of the shot, was a background in the sense that it could be manipulated from beyond the frame of the image itself. Above the aquarium was a reflective hood, open along its top, bottom, and back, which directed artificial light into the aquarium, and prevented it from directly reaching the camera, which was external to the scene. While the bottom was covered with gravel and rocks, the sides of the tank, which did not figure into the photograph, could be made by any material, even if it was opaque.

To Fabre-Domergue's regret, the artifice of his underwater tableaux inadvertently figured into the images. As an "effect of perspective," the rear angles of the aquarium were visible in the photographs and "deprived the landscape of its natural aspect." Instead of masking the angles by placing algae or rocks in front of them, Fabre-Domergue remade the aquarium into a trapezoid. The geometry of the tank marked the limits of the camera's point of view. From this initial modification followed another illusionistic effect. By removing the gray screen and placing a second aquarium directly behind the first, the depth of the "landscape" was greatly augmented. Instead of appearing silhouetted against the screen, the animals would seemingly occupy the background space external to their proper milieu. The "decoration" of the latter, he noted, could be much in a much freer manner since there was no risk of it being disturbed by the animals' "disorderly movements." In his attempt to restore and augment the natural aspect of his artificial landscape, Fabre-Domergue juxtaposed two distinct places, one in which the animals lived and the other in which they appeared photographically. A transparent plane of glass analogous to the picture plane separated the two. It was in discussing the artistic effects which could be achieved by varying the levels of light in the two aquaria that Fabre-Domergue reveals the

[35] Fabre-Domergue, "Photographies d'Aquarium," *Photo-Gazette* (1898), quoted in Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 303.

extent of preparation which went into his compositions. His concern for perspective was subservient to an overall sensibility to the picture: the impression, at the moment in which the image was taken, that the fish were "plunged in a veritable bath of light."[36]

Such a consideration shifted the burden of his attention from constructing settings to the problem of the spontaneity of his subjects. The actual "pose" involved an elaborate bit of choreography on the part of the camera operator. The aquarium presented an ever changing aspect, and the operator had to be constantly vigilant for the moment when "the ensemble of its inhabitants"—which, unlike the landscape, could not be arranged in advance—made for a good picture. Holding the camera's shutter release in one hand and the trigger for the aquarium's lamp in the other, the result depended on the cameraman's reflexive coordination of eye and hand. For the scene to be captured, the shutter had to be closed before the animals reacted to the light by changing their position. Though Fabre-Domergue imagined automating the release mechanisms, which required a bit of "cold blood" to operate, only the cameraman could select "the opportune moment."[37] But even an instantaneous response was not enough, and the fish left traces or gray streaks on the plate. Fabre-Domergue determined that it was best to wait until the animals were at rest, advising photographers to prepare by "seating themselves comfortably beside their camera." He worked at night, in a dim light, arranging everything in advance so as not to disturb the animals. As long as the operator, himself turned into an armchair naturalist, did not himself fall asleep, he could capture the animals while they were still.

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[36] Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 305.

[37] Fabre-Domergue, quoted in Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 304.

With the exception of "immovable species,"[38] however, aquatic animals were not often as cooperative as a photographer might wish. For this reason, the most stunning image in the Fabre-Domergue portfolio depicts a large lobster languishing on a rock, resembling an invertebrate Odalisque. Crustacea, and in one case a large octopus, make compelling subjects, seemingly found amid their hidden gardens. The images of fish—with the exception of one or two which seem to be reacting to the light—look artificially suspended in a cleverly contrived milieu which could well have been an embalming fluid. The overwhelming impression is that the scenes are decorative. In the best shots, subjects and their environment are balanced elements of the composition. In his published images, Fabre-Domergue had yet to implement the above-discussed modifications, and the back screen is seen to change its tonality in accordance with the animals being photographed. The animals themselves seem to ornament the screen, even as the details of the outline and markings are cast in relief by it. The rocks and algae, too, before they were given free rein as landscape elements in the second aquarium, frame the scene to picturesque effect. Finally, the somewhat random selection of subjects suggests they were not be put to systematic use. Rather, the images are remarkable for the efforts Fabre-Domergue made to structure photographically a milieu which was not readily visible, and for which few pictorial conventions existed.

Fabre-Domergue conceived of a landscape from a position visually connected to but spatially separate from the scene. Indeed, the scene existed in a frame of his own making. Boutan's photography took place within the underwater landscape. Without the filtering screen of the perfectly transparent glass picture plane, the sea itself became a primary element if not figure in his photographs. Reversing the process of acclimatization which

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[38] Ibid., p. 304.

Fabre-Domergue's subjects underwent when they were put into his aquaria, Boutan himself had to become accustomed to the sea—or at least to experience it from the interior of his diving suit. The suit was not only his life-support, but a perceptual container. As he described it: "faisant abstraction de sa lourdeur et du bruissement persistant de la pompe qui refoule l'air dans l'intérieur du casque, on arrive à se préoccuper uniquement des objets qui vous entourent, on est frappé de la diversité et de la beauté du paysage-sousmarine."[39] If Boutan could abstract himself from his suit's envelope, that only made his subject position analogous to that of his camera which was plunged in the watery mix. Without the separation which the aquarium offered, he was forced to wonder: "le milieu eau est-il impropre à l'obtention de bonnes photographies?"[40]

Where Fabre-Domergue had the luxury of waiting and watching, Boutan found that the precautions he took to make the camera and the diver "immobile" were futile considering that "le paysage lui-même était en mouvement."[41] Each of Boutan's successive designs for cameras overcame properties of water in the process of recognizing them as obstacles to making a clear image. He drafted with exacting detail the gaskets which hermetically sealed his camera. The context in which the camera was placed, however, was endlessly changing according to surface conditions, temperature, and direction of incoming light. The diving suit allowed Boutan a direct route into this "photographic field" (fig. 7.6–7). Indeed, Fol described the sea as a sort of studio: "l'éclairage du fond de la mer, tel qu'on le voit en y descendant en scaphandre, vient uniquement d'en haut. Il resemble à celui

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[39] Louis Boutan, "Mémoire sur la Photographie Sous-Marine," *Archives de Zoologie Expérimentale et* Générale, ser. 3, t.1 (1893), p. 283.

[40] Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 301.

[41] Ibid., p. 300.

d'une salle sans fênetres qui reçoit le jour par un vitrage occupant le milieu du plafond."[42] But Boutan soon discovered the diving suit was a less-than-perfect means of viewing the depths. His enormous efforts required to set up his camera caused him to perspire inside his heavy suit, so that sweat condensed on the window of his helmet to the point where "le paysage n'apparaissait plus q'à travers un brouillard opaque."[43] And though he wished to view the sea "sharply," this atmospheric effect was endemic to the landscape.

"La paysage a une poésie singulière," he wrote, adding that he had the sense of finding himself transported beyond the ocean to a tropical region far from France. And while his travel notes "translated exactly"[44] the impression he had of this lovely landscape, it was his inability to bring back "souvenirs" from the depths which gave him the idea to produce photographs. In taking the camera into the sea, Boutan lost all the stable reassurance of the frame, either as the ordered space of the cabinet of study or the photographic constructions of Fabre-Domergue. The element of the picturesque, of reverie even, in Boutan's photographs is a curious addition to his ideal of creating clear and distinct images. "Rien n'est pittoresque comme de suivre un de ces chemins tracés par le courant," he wrote, recollecting the sculptural effect of the fluid masses in the underwater landscape. Boutan was adrift and out of his element. He even reports losing awareness of his supply line and losing track of himself in this foreign world. That is, until a brusque tug came along his supply line, a signal from the captain of the team manning his life-support system asking if everything was all right. It is fair to say Boutan had become intoxicated with the milieu through which he moved.

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[42] Hermann Fol, "Observations sur la Vision Sous-Marine Faites dans la Méditerranée à l'Aide du Scaphandre," *Comptes Rendus des séances de l'Académie des Sciences* t. 110, #21 (May 27, 1890), p. 1079.

[43] Boutan, *La Photographie Sous-Marine*, p. 198.

[44] Ibid., p. 115.

Brought back brusquely to the task of photography, the problem before him was that the underwater landscape was "far from being immobile."[45] It was impossible for him even to move "without troubling the ambient milieu." With each step his lead-weighted boots stirred up a cloud of silt from the sea floor, which remained suspended for minutes at a time, obscuring the lights. But even when he moved to another site which had more vegetation and a solid floor, the currents caused the vegetation to sway, which due to the photograph's long exposure time resulted in hazy images. The solution had to be found in the ability to take instantaneous poses. He could bracket the fluid elements which passed in front of the camera's lens by limiting the exposure time. The fluid and the neat elements of Boutan's photography are resolved in the question of the camera's focus.

Where the screen has already appeared in our discussion as a visual target in Forel's experiments, and as the backdrop of Fabre-Domergue's aquaria, for Boutan it served as a quasi-literary device to announce the very nature of his project. After a first series of truly enchanting landscapes in which Boutan was still testing his camera, he produced another series in which figured a large white screen painted with the words: "Photographie Sous-Marine." With his camera placed on the sea's bottom, the screen which it faced represented "le fond de la photographie."[46] Boutan used the screen as a background against which to cast animals in sharp relief; Boutan placed bait in front of the screen to lure fish into the shot. In one image, Boutan noted the sand which had washed onto the screen itself, the latter serving as register of the mobility of the water. In his book, Boutan included didactic diagram of shots, shown in cross-section through the water; he explained,

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[45] Ibid., p. 189.

[46] Boutan, "L'Instantané dans la Photographie Sous-Marine," p. 324–25.

> L'intérêt de cette photographie ne réside pas seulement dans la netteté de l'image, il consiste surtout dans ce fait que l'appareil, bien qu'il fût immergé à 3 mètres de profondeur comme l'objet à photographier, a été manœuvré hors de l'eau.[47]

The "sharpness" of the image is remarkable, showing as it does the bubbles escaping from the mechanic's helmet. The use of the screen coincided with the removal of the subjective element from the production of the photograph. This meant in effect giving up the idea of a photographic promenade and establishing an underwater photographic station.

Like the term "Photographie" which appeared on the sides of Parisian buildings as seen from Nadar's balloon in the famous drawing by Daumier, the screen spelled out the conditions of legibility of underwater photography (fig. 7.8). Either viewed from a balloon or from the window of a diving suit, the world literally becomes legible as a photograph. The sign serves as the background for photography while advertising its arrival on the scene. The screen served as a way of determining its focal distance, which would subsequently be used to arrange the shot. The diagram Boutan included in his book of the curious apparatus designed to test the camera's focal range resembles nothing so much as a studio turned on its end. Notably, the space occupies the Arago laboratory's dry-dock, which was itself built to ensure that the research station's means of collecting specimens would always be in good repair (fig. 7.9). Suspended from two planks of wood which spanned the sides of the dry-dock, the camera's lens was directed down into the basin of calm water at the bottom of which the "Photographie Sous Marine" screen had been placed. The camera's photographic plate was replaced by a frosted glass on which the screen could be sharply focused. At that point there was no longer any need of a photographer in the water along with the camera. When the time came to take pictures of the sea, a chassis kept the screen at a fixed distance

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[47] Ibid., p. 327.

from the camera, defining the background of the shot and the focal range. It marked the optical limit of what came into view.

Boutan's eventual use of electric lights was as much an important technical innovation in his effort to photograph the obscure depths as it was the occasion for him to marvel at the scene they created. As in his notes recording his impression of descending on Banyuls for the first time, Boutan wrote that the "spectacle" of the lights were "gravés dans mon souvenir."[48] Working from one of the laboratory's ships, his crew set up the shot by lamp light, the mist which enshrouded them taking on a "fantastic allure." Again, it was the crew who shook Boutan from his reverie. Less concerned than he was with "poetry of the nocturnal scene" above the water's surface, they were busy preparing the lighting apparatus and the camera to be lowered into the depths. With the arduous task accomplished, they tested the lights: "Le fond s'allumine, et tous les objects situés dans le champ de l'objectif apparaissent avec beaucoup plus netteté que pendant le jour."[49] In the very depths which had been veiled in obscurity—of physical and philosophical nature—things could be seen as clearly as in the light of day. Curious mariners, watching from the shore, cried out for an explanation for what was taking place, as if they were witnessing the unearthly phosphorescence of the *Nautilus.* The order was given, and the camera's shutter opened, and after the count of five closed again. As the camera was hauled to the surface, a wave of anxiety washed over Boutan, causing him "une légère palpitation de cœur." With the photographic plate still enclosed within the camera, they waited to know: "Y aura-t-il un image? la plaque a-t-elle été impressionnée pendant la courte pose? les objects étaient-ils au

[48] Ibid., p. 253

[49] Ibid., p. 254

point?" The question could only be answered once the plate was hastened to the darkroom.[50]

The picturesque, embedded in sensibility and memory, seemingly was for Boutan a consoling manner of seeing, protecting him from melancholy of a sort, prompted by the threatened loss of sight. It resisted the absorption of the very possibility of perception into the all pervading ether out of which is wrested that which is visible (fig. 7.10). Perhaps Nadar captured the sentiment best, in his description of his photographic promenade through the catacombs, a place everyone wants to visit, and to which no one wants to return:

> Grimpons donc cet escalier qui semble à notre impatience plus interminable encore qu'à la descente,—et voici l'air suave du dehors, voici la lumière, le soleil, la Vie, qui chassent derrière nous comme un rêve pénible, pis encore, ennuyeux, le souvenir de cette excursion funèbre.[51]

Not that this condition of uncertainty was inherently inimical to scientific vision; nor was philosophical sanction required to plumb the depths of transparency itself. Rather, the photograph became a practical conveyer of knowledge at the limits of what can be seen and known. Boutan and Dubois both surveyed an extensive panorama which showed what little mooring human vision had in the nether regions of light which bracketed the visible. The sea itself was already the site for a discourse on the perils of optical subjectivity, of losing land and of being lost at sea. Boutan simply eschewed the safety of watching from shore, or peering into the mix from the front of an aquarium, and instead entered into its depths with his camera before him.

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[50] Ibid., p. 254.

[51] Nadar, *Quand j'étais photographe* (Paris: Ernest Flammarion, s.d.), p. 112.

Chapter VII

THE PALACE OF OPTICS

These various strains of research into vision could be said to culminate in the Universal Exposition of 1900, which itself recapitulated a century of labored progress. The Palace of Optics surveyed the regions into which vision had penetrated, but darkly hinted at how out of place the human eye was amid them. Among the objects on display, an enormous refracting telescope, the largest ever built, was to be used in an international project to produce a photographic star charts. Yet as Boutan noted, if in sidereal photography the limit of the lens's reach into the upper atmosphere was limitless, the "conditions" in which underwater photography took place were altogether different.[52] This was demonstrated by Boutan's photographs which were projected onto screens on the walls of the palace. The images offered glimpses into a region which was shrouded in a tenebrous darkness, a place of disappearance: the unseen depths of the sea. An experience of the otherworldly aspect of the sea was on view in the lower level of the palace. As Dubois described it, "I illuminated the vast basement of the Palace as if by the loveliest light of the moon." The source of this "cold" light were the globes filled with bioluminescent organisms. Dubois also displayed by the light of the lamps themselves the photographs he made in which the lamps figured. Though the sights of this optical palace were split between its basement and its attic, the depths of the sea and the vault of the sky, the view was in some respects the same. Quatrefages wrote than under magnification, the bioluminescent granule resembled "distinct points of light, like that of a nebula as seen through a telescope."

While the two phenomena, one bordering on the infinite, the other minute, appeared alike when seen through their respective optics, the condition of their visibility was radically

[52] Louis Boutan, *La Photographie Sous-Marine*, p. 290.

different. The palace, which shared with the other pavilions at the Exposition its spectacular character, made a constellation of them. But in less obvious ways, the instruments and images on display there refer to these ambiguous conditions. They were the artifacts of an ongoing effort to bridge the widening chasm which photography had helped to expose between the visible and the invisible. In the process of testing the limits of photography, the milieu which separated and enveloped these not always bordering states of perception became a subject for photography itself. Boutan's concern with the conditions of underwater photography leads to the question of how things look under water. The critical threshold at which light failed to penetrate this milieu defined where photography and presumably vision ceased to have a place. And who or what was doing the looking? In these asphyxiating depths it was not man, at least not without the aid of diving a bell. Gillian Beer has explained that images of the sea were intrinsic to new understandings of a luminiferous ether in which the eye and its variously conceived stand-ins were awash. "The work of scientists disturbed all oppositions of inside/outside, invisible/visible. Instead of disclosure or exposure—the hauling of hidden into the light—all life becomes a medium, a discharge, or a pathway."[53] The sea was an uncertain harbor of visual certainty.

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[53] Gillian Beer "Authentic Tidings of Invisible Things," in Teresa Brennan, Martin Jay, eds., *Vision In Context* (New York: Routledge, 1996), p. 88.

CONCLUSION

Drawing on his own experience working along shore as if he were a real-life Crusoe, Lacaze-Duthiers described the fraught moment Milne-Edwards set out on an "unmarked route" leading to the edge of the sea: "He, a professor at the Muséum and at the Sorbonne, member of the Institut, he went far from his family, far from his [academic] chairs," to study the emergence of organized life in the embryo, "plunging himself into the sea."[1] Milne-Edwards left all that was familiar, even the familial foyer, to immerse himself in a dense vital and visual milieu, his very movements limited by the apparatus which made it breathable. At the time, there were no stations along shore which would restore to him the identity, the comforts, or even the research instruments which he enjoyed in the city. He was abroad in the field of nature. The act of decamping from the precincts of the city is the radical gesture initiating a tradition of research which this dissertation has sought to establish. It was a tradition structured by a profound intuition about the way place constituted knowledge; knowing these places meant creating not only a home away from home, but creating institutions which had an enduring relation to changeable landscape.

A final element of Milne-Edwards's intellectual legacy serves to highlight the salient features of the development of the research stations which represent one end point of this tradition. In *La Cité Moderne* (1898), the sociologist Izoulet examined to the point of systematic tediousness the structural and dynamic similarities of organic and social "associations." According to Perrier, Izoulet's book was the fruition of Milne-Edwards's seminal concept of the physiological division of labor, a feature of human society which stemmed from the prudent management of the household. The focus of Perrier's own

[1] Pruvot, "Lacaze-Duthiers," p. 18.

research on animal multiplicities, or "colonies," no doubt made him eager to emphasize the connection between Milne-Edwards and his student Izoulet.[2]

According to Izoulet, human society was more interesting than animal society in one crucial respect: human society presents to the observer not an "accomplished city," but a "city in the making."[3] The city of man was an evolving entity; man's very capacity to analyze its order, Izoulet wrote, was the result of the parallel evolution of his own intellectual faculties. Knowledge is the measure of power, he wrote; man is, among animals, the one who knows the most. Why? Because the city of man is the only type which has advanced far enough to promote a "corporation of savants," a class devoted exclusively to the cultivation of intelligence.[4] In the well-ordered city, they lived amicably with laborers, tradesmen, and fellow civilians of every variety.

The research stations which developed along the coast could be regarded as examples of cities in the making, especially when seen in the context of the formative factors described by Izoulet. The history of the city, he wrote, can be studied from two distinct points of view: one external and one internal. The external one views the city as a "territorial formation" which results from the pressure of human groups upon one another and the differential perfection of the races.[5] The city is an artifact of paths of movement

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[2] Edmond Perrier, Les Colonies Animales et la Formation des Organismes. The concept of association and the social organism would have a profound influence on the twentieth-century intellectual avant-garde, including Georges Bataille and Roger Caillois, see Denis Hollier, ed., *The College of Sociology 1937–39*, trans. Betsy Wang (Minneapolis: University of Minnesota Press, 1988).

[3] Jean Izoulet, *La Cité Moderne* (Paris: Félix Alcan, 1898), p. 74. Perrier wrote that Milne-Edwards's concept of the division of labor was the singular insight which led to the creation of the chair of sociology at the Collège de France held by Jean Izoulet; the influence of Milne-Edwards's in the field of sociology is discussed by Camille Limoges, "Milne-Edwards, Darwin, Durkheim and the division of labour: a case study in reciprocal conceptual exchanges between the social and the natural sciences."

[4] Izoulet, *La Cité Moderne*, p. 254.

[5] Here, Izoulet refers to Auguste Himly, author of *Histoire de la formation Territoriale des États de l'Europe* (Paris: Hachette, 1876). The notion of territory has recently taken on great theoretical significance through the writings of Gilles Deleuze and Félix Guattari who describe "deterritorialization" as a method of way of stabilizing an assemblage of related but distinct elements or intensities in an order which remains open to change through

and patterns of settlement. The internal point of view refers to the "genesis of institutions," or the organization of social structures.[6] It was in transfiguring the intimate nature of his intellectual faculties, argued Izoulet, that man transformed his external conditions of existence.

In discussing the genesis of institutions, Izoulet referred to the historian Fustel de Coulanges, whose monumental work, *La Cité Antique*, explained the centrality of religious institutions to the development of the city. These institutions represented the extension into civic life of the mode of observance which attended the domestic hearth. To be sure, the institutions which gave rise to the modern city of science were not defined, as they were in antiquity, by the veneration of the dead but rather by the desire to study living nature. Yet as we have seen, the devotional, or more importantly the familial connotations of the foyer were re-deployed in the act of maintaining the scientific household. Science was the secular religion of the Third Republic; endowing research institutions took on urgency in the historic situation in France post-1871. Just as importantly, the house rules in effect at the research stations shaped not only the researcher's approach to the study of nature, but his relationship with fellow researchers. In instituting this domestic order, the station allowed naturalists to dwell on the premises of their research. The historic evolution of the norms and forms of the domestic foyer over the course of the nineteenth century were selectively mirrored in the terms of hospitality which governed the scientific household.

Why discuss the city when the initial point of this study was the departure of some of the most talented of France's naturalists from Paris? Were not these naturalists in fact involved in an act of de-institutionalization? The research stations represented the possibility of forming new institutions, which bore meaning in relation to the very circumstances out of which they emerged. The city as it is being presented here is an

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dynamic interaction and exchange, see *A Thousand Plateaus: Capitalism and Schizophrenia* (Minneapolis: University of Minnesota Press, 1987), pp. 3–25.

[6] Jean Izoulet, *La Cité Moderne*, p. 76.

association of habitations, the habitation itself an association of specialized workers. The city is not to be understood as an immured entity, but an evolving pattern of interaction. It is the origin of order, the *civitas*. For this reason the study began with a series of movements and the use of statistics as a means of establishing the status of things in space and time. The circumstances in which an architectural intervention could take place serve as the study's area of inquiry, rather than any design which takes shape on the architect's drafting table.

From an architectural point of view, the research stations were literally non-canonical; they were conceived in the belief that all available resources should be committed to creating the proper conditions of research as opposed to adorning the resulting institutions with columns. But if their design does not warrant sustained discussion, the argument here has been that they present an important opportunity to witness the emergence of a modern building type, the laboratory. The laboratory, in its reduction of programmatic concerns to the elements of space, air, and light, frees itself from the weight of accumulated forms and history through which the Beaux-Arts architecture of the nineteenth century sifted. The stations represent an approach to time, place, and circumstance which was in essence modern.

The emergence of the station as a type of modern city required leaving the walls of the antique city. In making the acquaintance of the sea, as Quatrefages memorably describes his first experience of the broad tides along the coast of Normandy, the naturalist defamiliarized himself. This resulted in part from the fate of man's vision, chief means of knowing the world and orienting himself within it. After the period of transporting his seat of observation had given way to the establishment of fixed stations along shore, the certainty of vision had been undone. Our history traced the trail of debris leading to the wreckage of stable distinctions between subjects and objects, figure and ground, light and dark. The naturalists who encountered this dilemma, however, had the reassurance of returning to their stations along shore. It was a refuge from the mutual threat of sensory overload and sensory deprivation posed by the sea at the edge of which they were poised.

With Milne-Edwards's fictional student Professor Arronax as its prisoner, Jules Verne's *Nautilus* detached vision not only from the museum—elements of which were reproduced within its hermetic confines—but from all mooring to the life of nations on land. The vessel provided a mobile means to experience a mobile element. In penetrating the surface of the sea, entering its visual milieu, the most contradictory modes of perception resulted. The very primacy of the eye as an organ of sight or the sun as a source of light ceased to serve as a signpost of experience. The sea absorbed all the quantifying instruments, cameras, sensors, eyes human and otherwise which were plunged into it.

Nemo's vessel paradoxically represented a return to the homeland of bourgeois culture. Nemo unveils for his captives the forces of technology which allow them to explore the most mysterious depths. But it is Nemo's lavish suite of rooms, his library, gallery, study, which stir Arronax's envy, forcing him to compare them to his own installation at the Muséum. The ship was not ultimately the model for the mode of experience we have been studying. But the dream of a type of domesticity attached to the mobility which the ship promised, witness the ill-fated journey of the *Aster*, underlies a tension which was endemic to the emergence of the city itself. The station was a point of departure and of return; it made the daily rounds of research if not predictable, than at least manageable.

The nature of experience had to be remade out of the very elements of place. On the eve of modernity, the experience of the displaced researcher was not that the center will not hold, but that he would not be held to the center. Provided with the light, air, and space of the laboratory, and its special furniture, observation and experiment find a place of accommodation. The question of managing time, place, and circumstance, which was first posed when the researcher made himself mobile, leaving the confines of ordered space and choosing instead to find the order of space, takes form only in the context of an evolving disciplinary landscape. Functioning both as stations and habitations, these research institutions established, for the time being, the naturalist's place once he passed beyond the walls of the city. Making himself at home at the edge of the sea, he institutes a corporation of savants around him. A city is formed on the periphery of the known world. There our naturalists settled in to their new occupation of research, but only after following a difficult and unmarked route.

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Travaux Publics		
F^{14}	13610	Ports Maritimes et voies navigables. Pisciculture.
Instruction Publique		
F^{17}	2988	Service des voyages et missions
F^{17}	3014 B	" "
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18	Enseignement

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1792	Lecture notes

C. Bibliothèque Centrale du Muséum Nationale d'Histoire Naturelle, Paris

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D. Institut Français d'Architecture, Paris

35/41	Louis Bonnier. Laboratoire de Zoologie Maritime

E. Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie

The archives are unclassified. They include a collection of historic photographs documenting the laboratory's construction and operation; Eugène Ramon's building plans; clippings files; correspondence and miscellaneous writings of Lacaze-Duthiers. Lacaze-Duthiers's private notebooks, which have been transferred to the station from the archives of the Académie des Sciences, have been partially inventoried by Georges Petit. "Henri de Lacaze-Duthiers (1821–1901) et ses 'carnets intimes.'" In *Communications du Premier Congrès International d'Histoire de l'Océanographie, Monaco 1966* (1968): 453–465.

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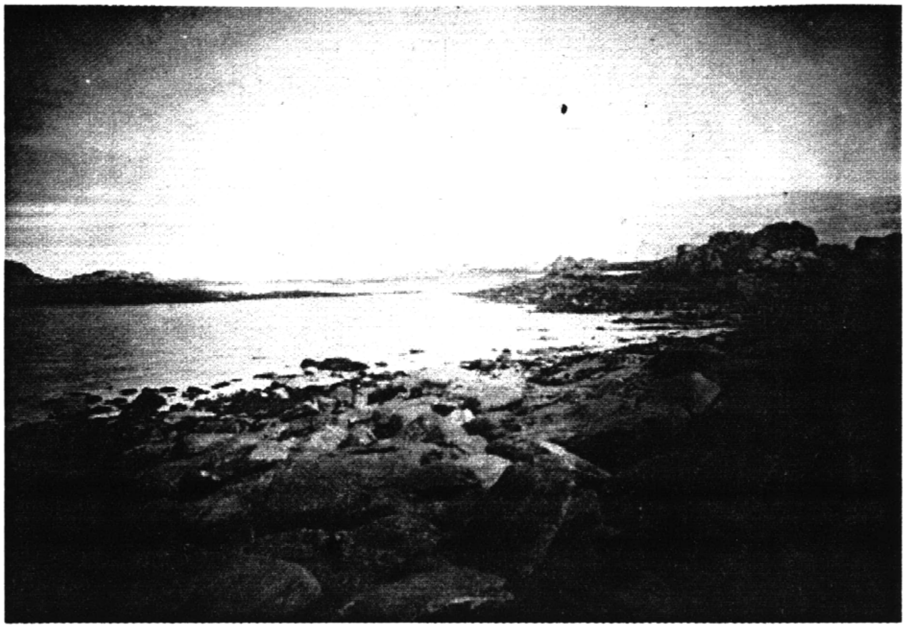


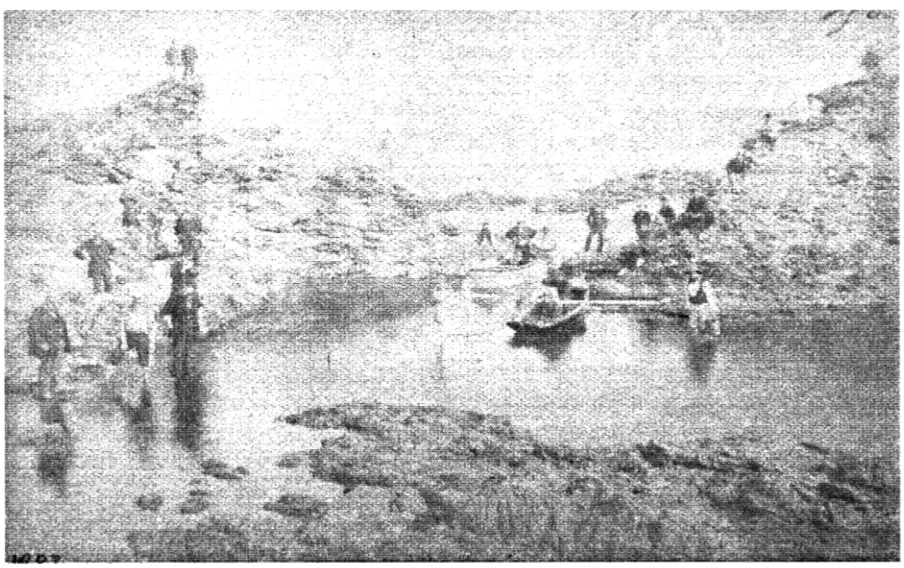


Fig. 1.1 (above) The low tide near Roscoff in Brittany. Archives of the Station Biologique de Roscoff. Fig. 1.2 (below) Collecting excursion at Banyuls s/m (1883). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

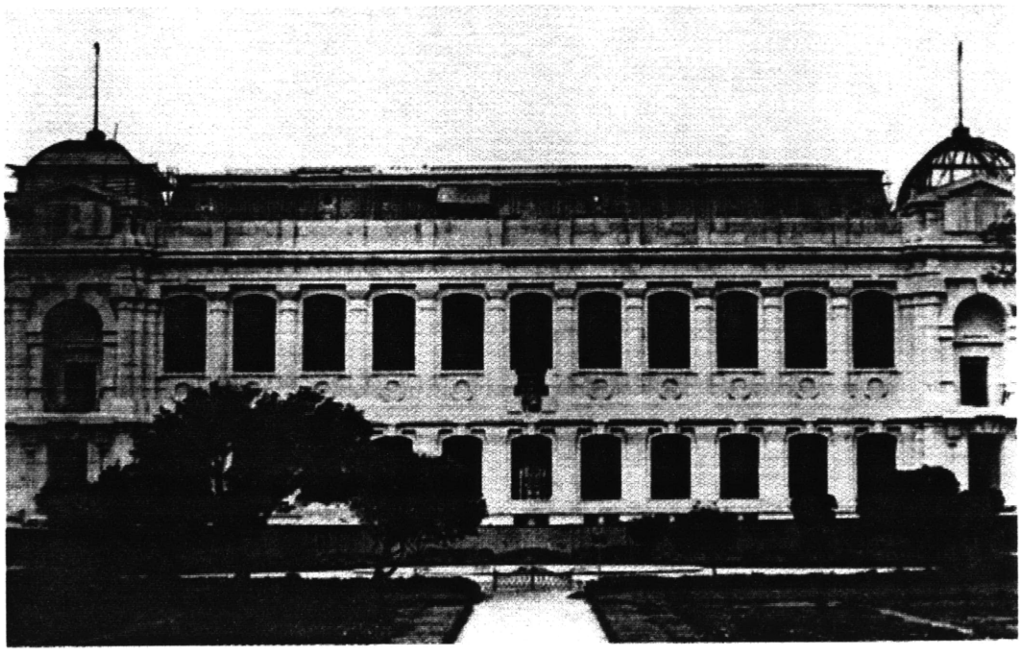


Fig. 1.3 Façade of the new galleries of natural history during construction (1888), Jules André architect. Bibliothèque Centrale du Muséum d'Histoire Naturelle, Paris.

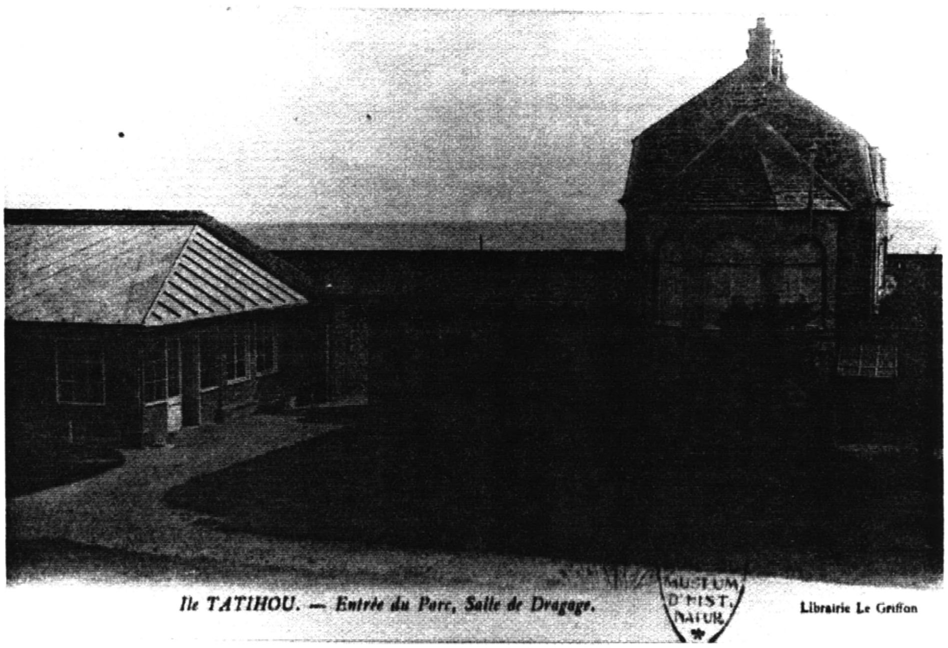
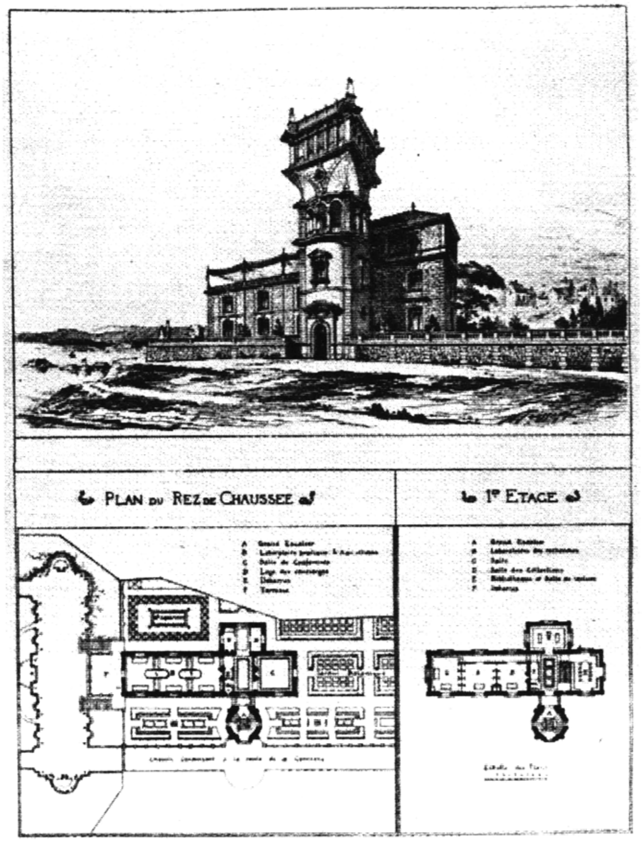


Fig. 1.4 (above) Île Tatihou, view of central laboratory and water tower. Fig. 1.5 (below) Île Tatihou, trawling-net room and former chapel. Bibliothèque Centrale du Muséum d'Histoire Naturelle, Paris.



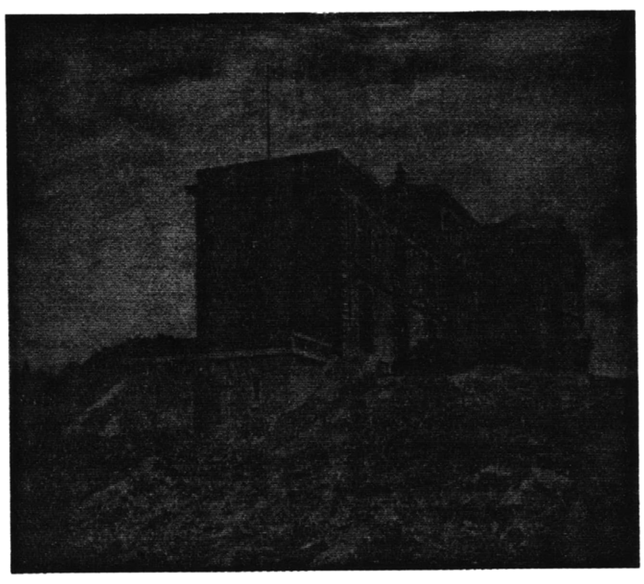
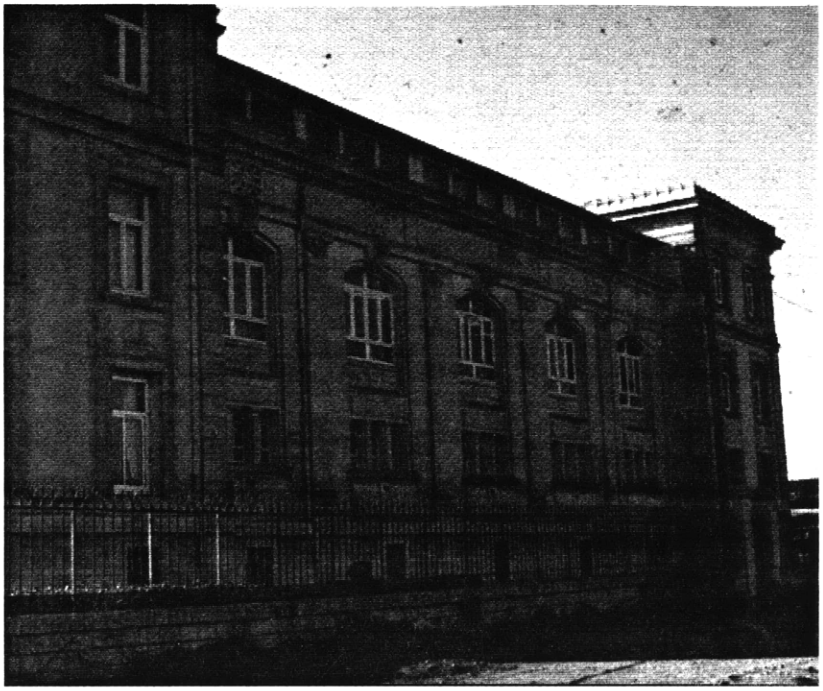


Fig. 1.6 (above) Ernst Paugoy, laboratory of Endoume. "Laboratoire de Zoologie Marine à Endoume," *La Construction Moderne* (December 4, 1886), p. 88. Fig. 1.7 (below) Laboratory of Endoume (ca. 1900). Archives of the Station Marine d'Endoume.



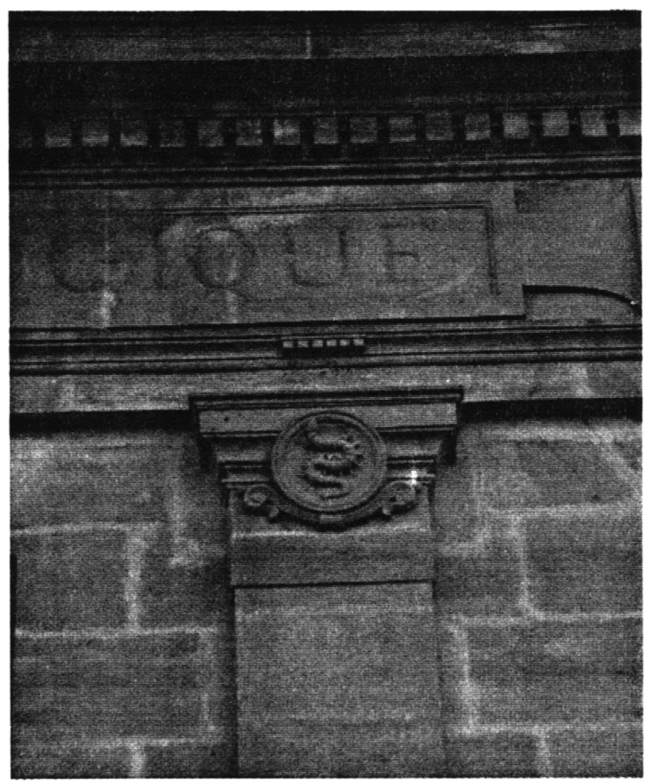


Fig. 1.8 (above) Façade of laboratory of Cette; Fig. 1.9 (below) Pilaster detail, laboratory of Cette (Author's photograph).

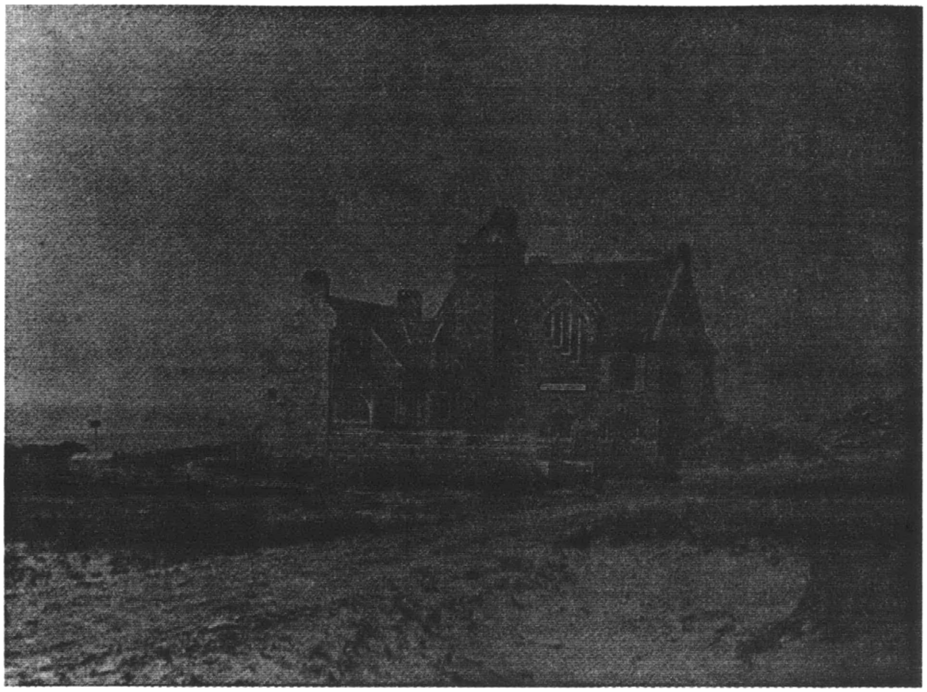


Fig. 1.10 Laboratory of Wimereux (ca. 1890). Institut Français d'Architecture, Louis Bonnier collection, No. 35/41.

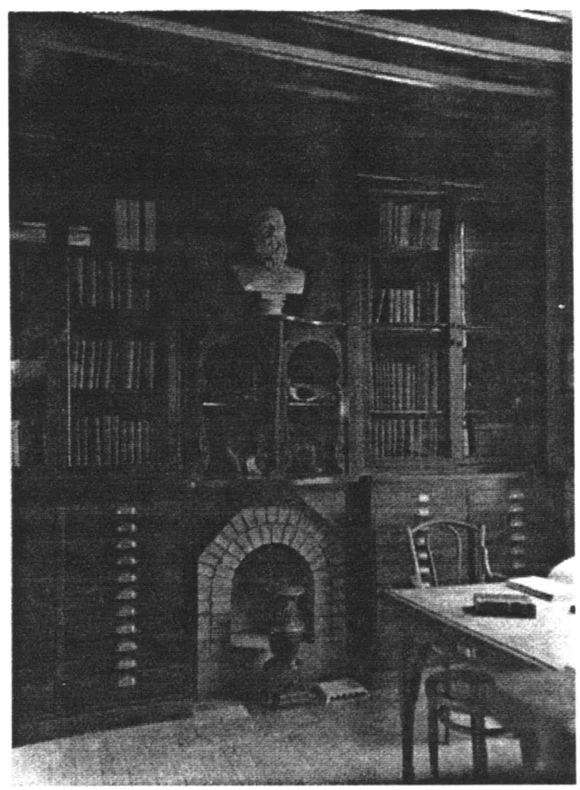


Fig. 1.11 (above) Laboratory of Wimereux, main research room. Fig. 1.12 (below) Laboratory of Wimereux, library. Institut Français d'Architecture, Louis Bonnier Collection, No. 35/41.

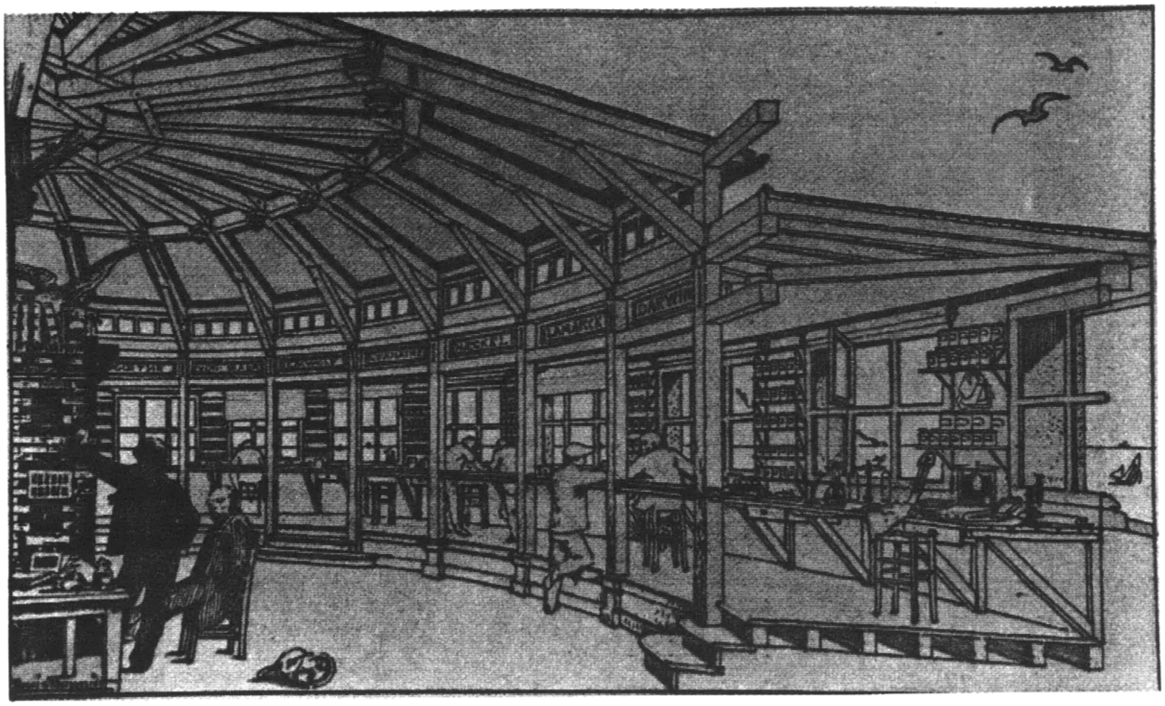


Fig. 1.13 Louis Bonnier, study for Wimereux, Institut Français d'Architecture, Louis Bonnier collection, No. 35/41.

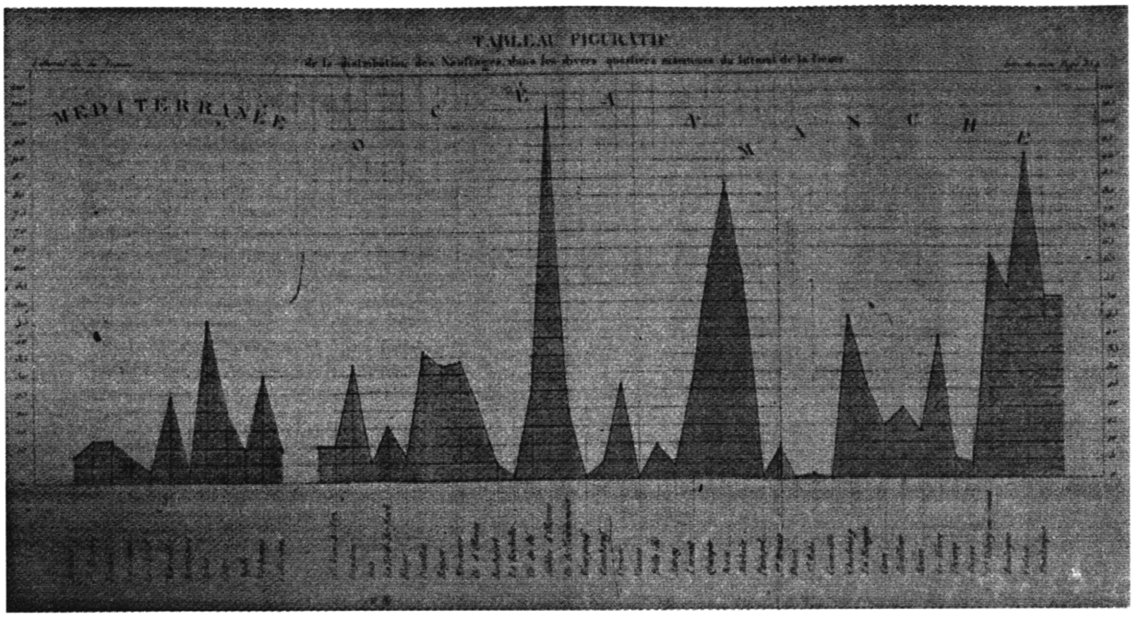


Fig. 2.1 "Tableau Figuratif de la Distribution des Naufrages dans les Divers Quartiers Maritimes du Littoral de la France." Jean-Victor Audouin, Henri Milne-Edwards, *Recherches pour Servir à L'Histoire Naturelle du Littoral de la France* (Paris: Clochard, 1832).

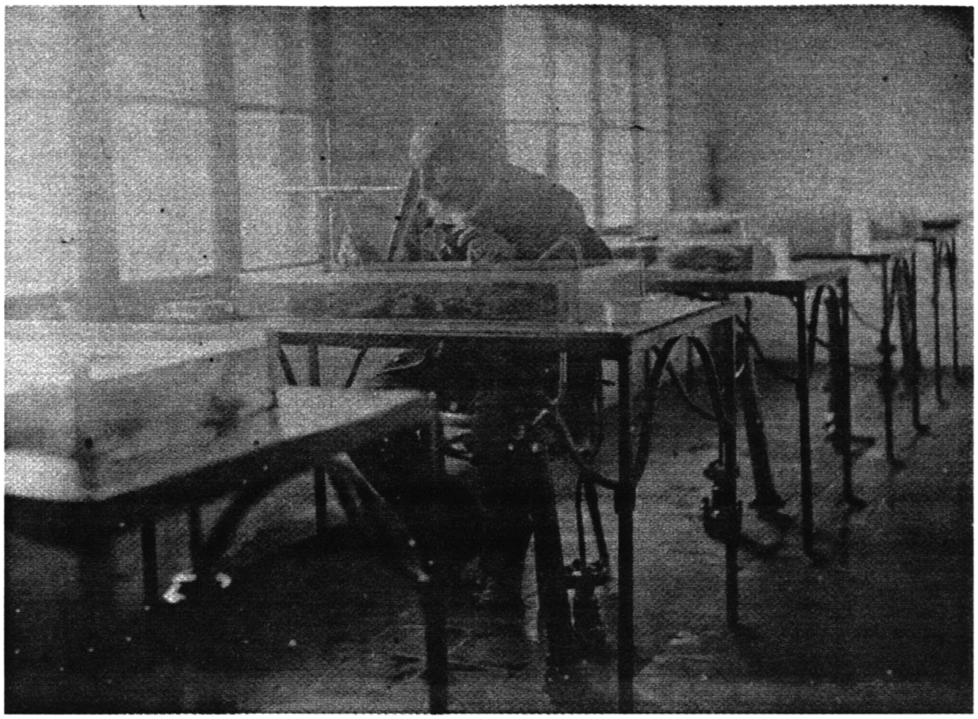
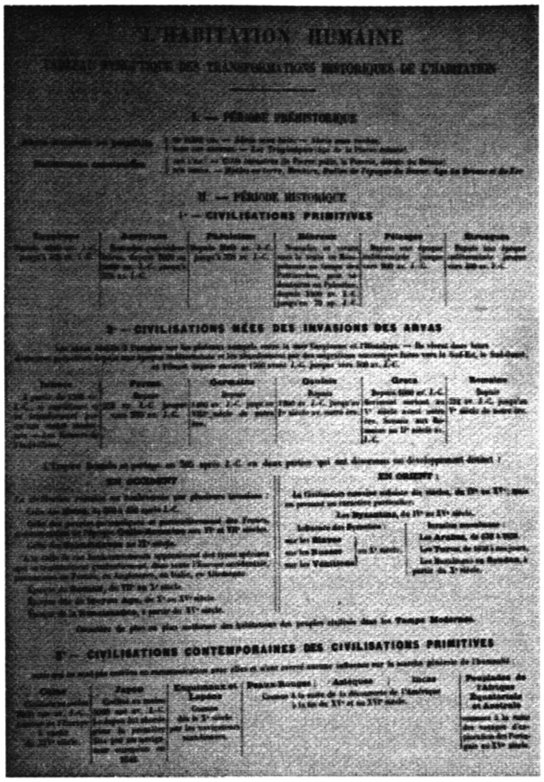


Fig. 2.2 Lacaze-Duthiers working at the study basins in the central research room of the Arago Laboratory. Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.



L'HABITATION HUMAINE

I. — PÉRIODE PRÉHISTORIQUE

II. — PÉRIODE HISTORIQUE

1° — CIVILISATIONS PRIMITIVES

2° — CIVILISATIONS NÉES DES INVASIONS DES ARYAS

3° — CIVILISATIONS CONTEMPORAINES DES CIVILISATIONS PRIMITIVES

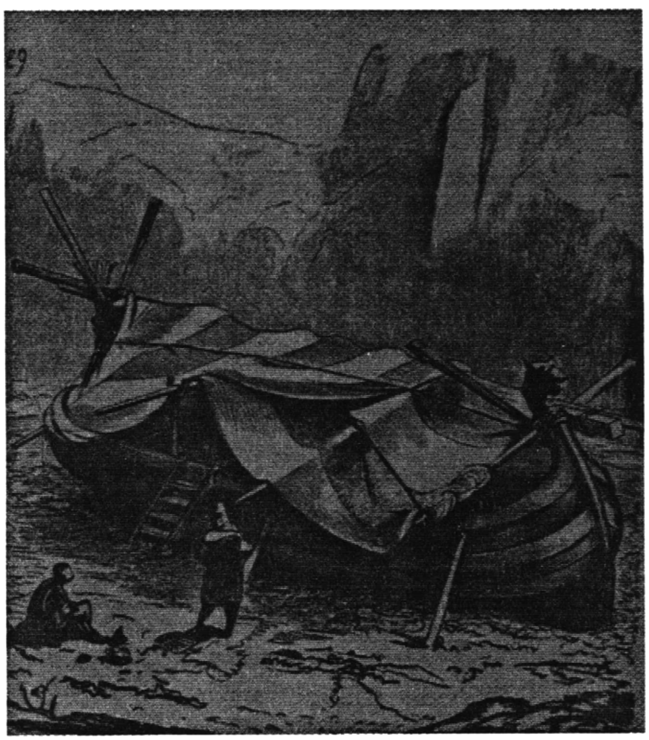
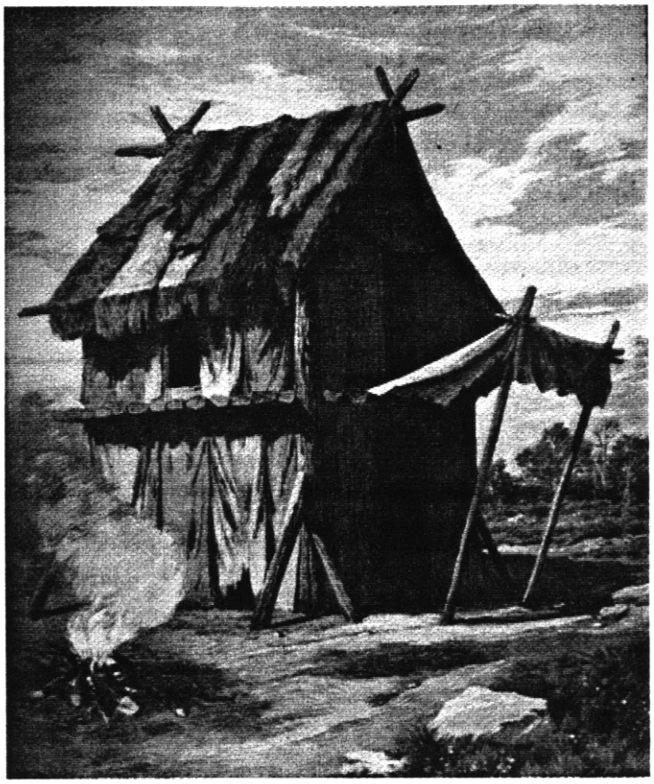


Fig. 3. 1 (above) "Tableau Synoptique des Transformations Historiques de L'Habitation." Charles Garnier, Auguste Ammann, *L'Habitation Humaine* (Paris: Hachette, 1891). Fig. 3.2 (below) Viking ship and habitation. Eugène Viollet-le-Duc, *L'Histoire de l'Habitation Humaine* (Paris: Bibliothèque d'Education et de Recréation, [1875]).



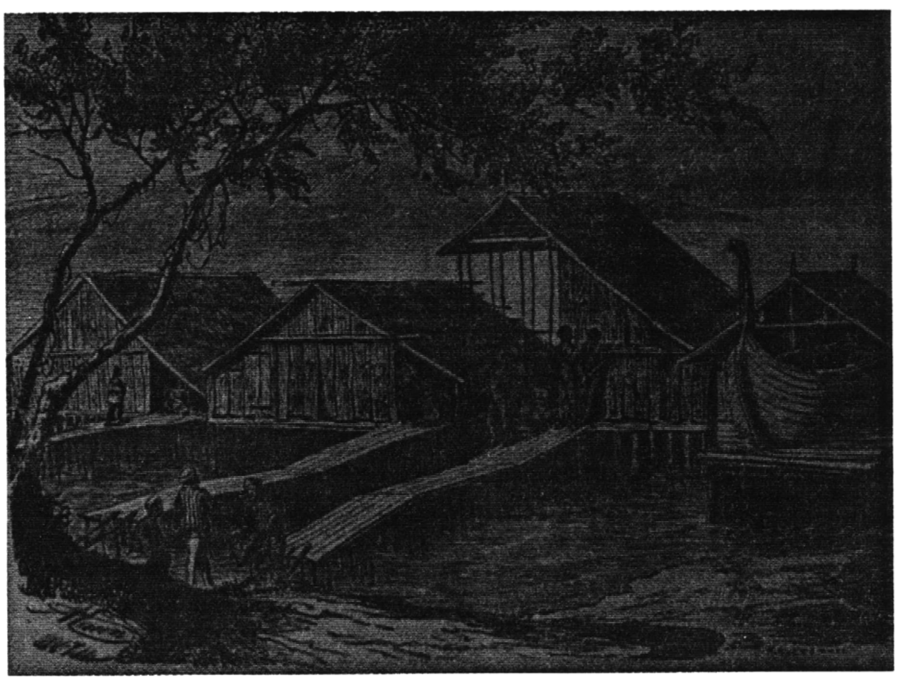
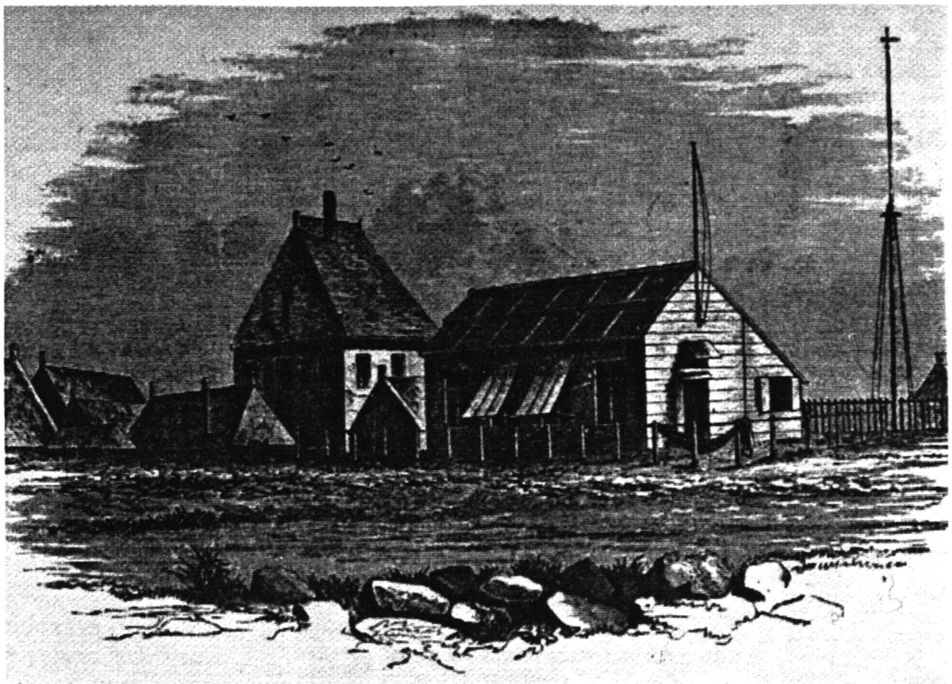


Fig. 3.3 (above) Tent and camp site of the Aryan migrants. Fig. 3.4 (below) Pile houses of New-Guinea. Charles Garnier, Auguste Ammann, *L'Habitation Humaine* (Paris: Hachette, 1891).



Station zoologique transportable telle qu'elle était installée à Helden (Pays-Bas), en juillet 1876.

Fig. 3.5 "Flying Station" of the Dutch Zoological Society. "Une Station Zoologique dans la Mer du Nord," *La Nature* no. 190 (January 20, 1877), p. 121.

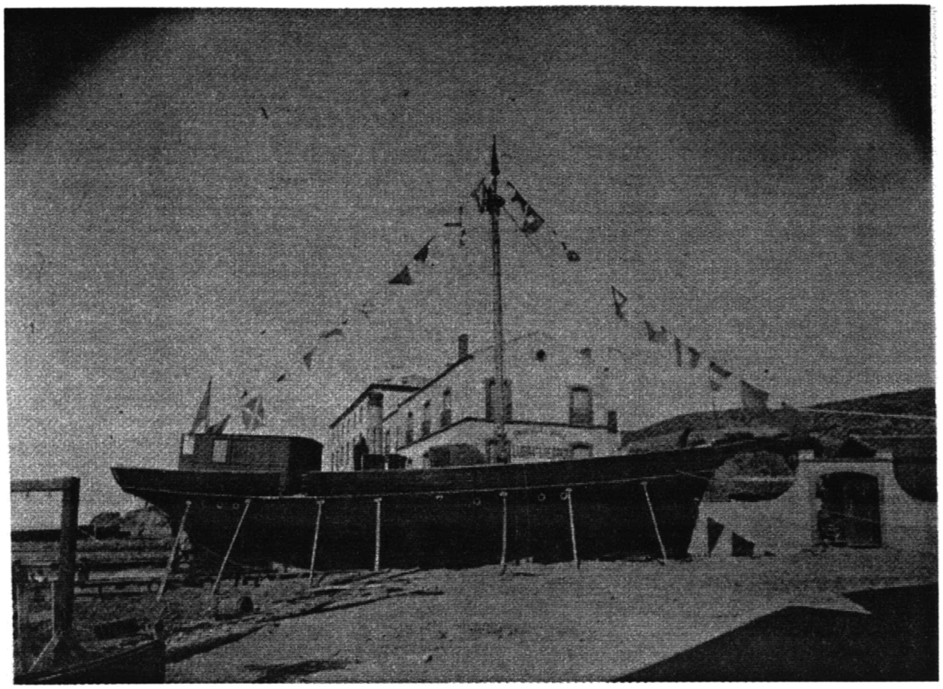


Fig. 5.1 Construction of *Roland II* at Banuyls s/m. Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

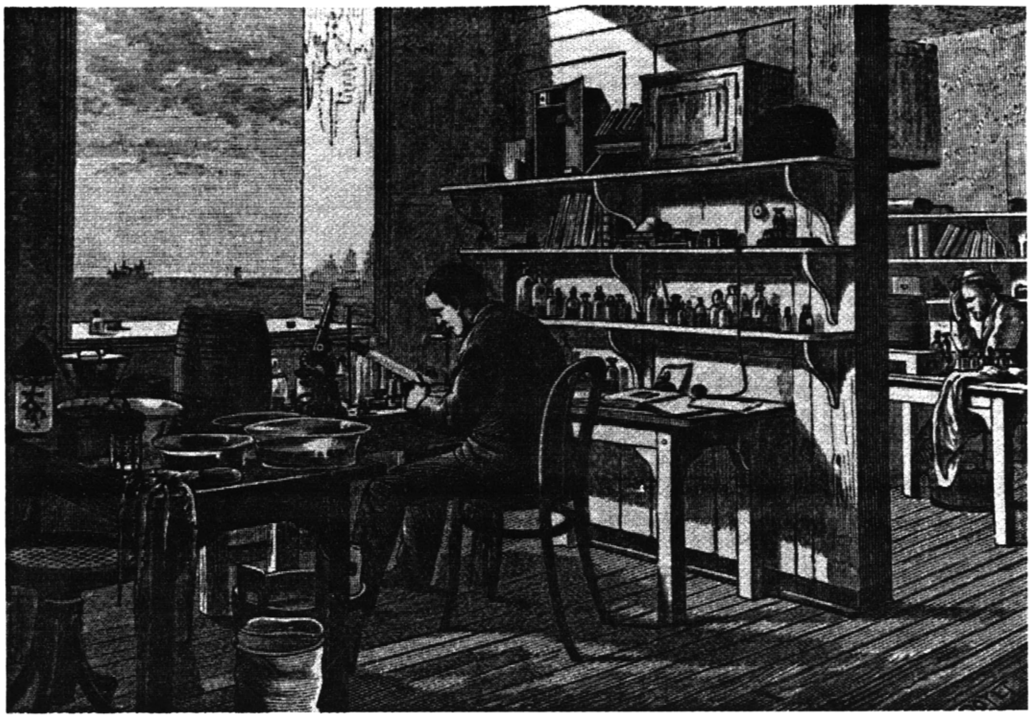
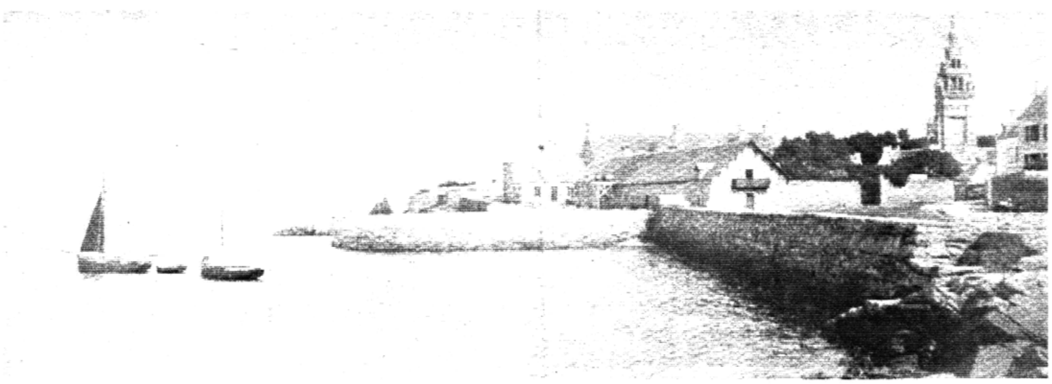


Fig. 5.2 Research room at Roscoff, showing the three-sided desks. Henri de Lacaze-Duthiers, "Les Laboratoires Maritimes de Roscoff et de Banyuls en 1891," *Archives de Zoologie Expérimentale et Générale* t. 9, ser. 2 (1891), p. 269.



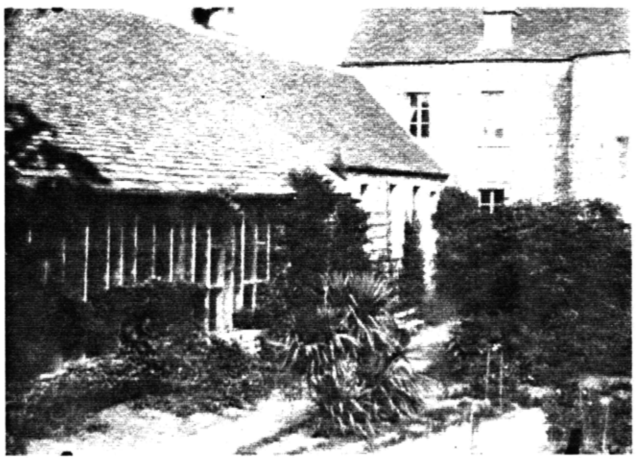


Fig. 5. 3 (above) View of Roscoff from the sea (ca. 1890). Fig. 5.4–5 (middle) Views of the garden of the laboratory of Roscoff, with aquarium wing to the left and laboratory wing to the right. Fig. 5.6 (below) Façade of laboratory, Place de l'Eglise (ca. 1900). Archives of the Station Biologique de Roscoff.Archives of the Station Biologique de Roscoff.

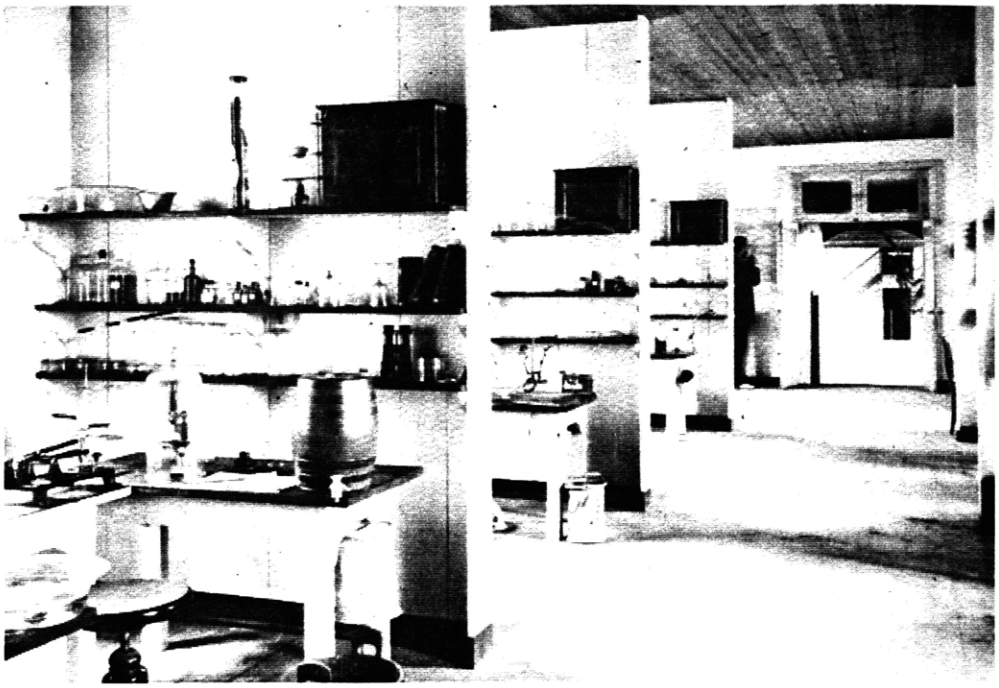


Fig. 5.7 View of research room, laboratory of Roscoff (ca. 1890). Archives of the Station Biologique de Roscoff.

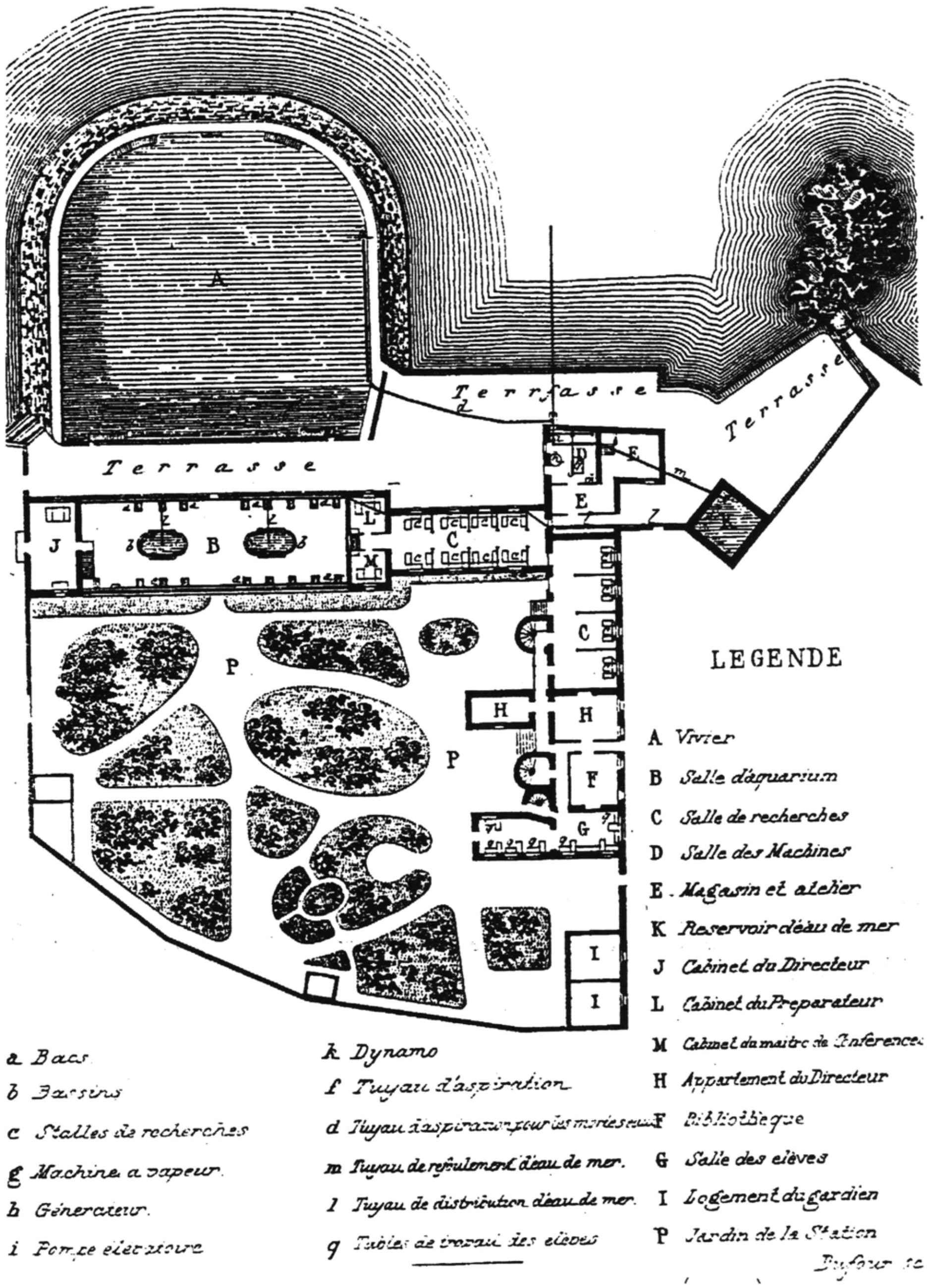
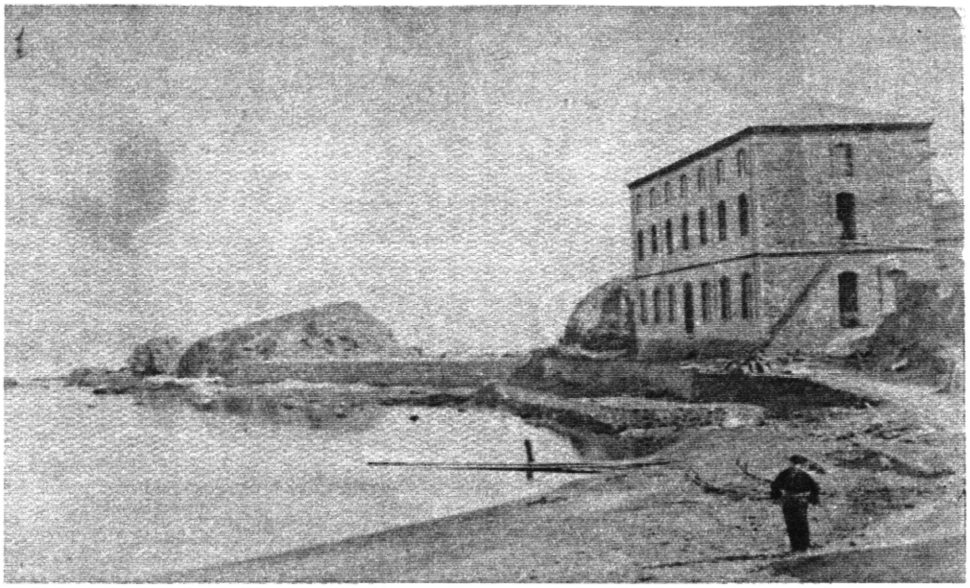


Fig. 5.8 Plan of Roscoff (1891). Henri de Lacaze-Duthiers, "Les Laboratoires Maritimes de Roscoff et de Banyuls en 1891," *Archives de Zoologie Expérimentale et Générale* t. 9, ser. 2 (1891), plate XIII.



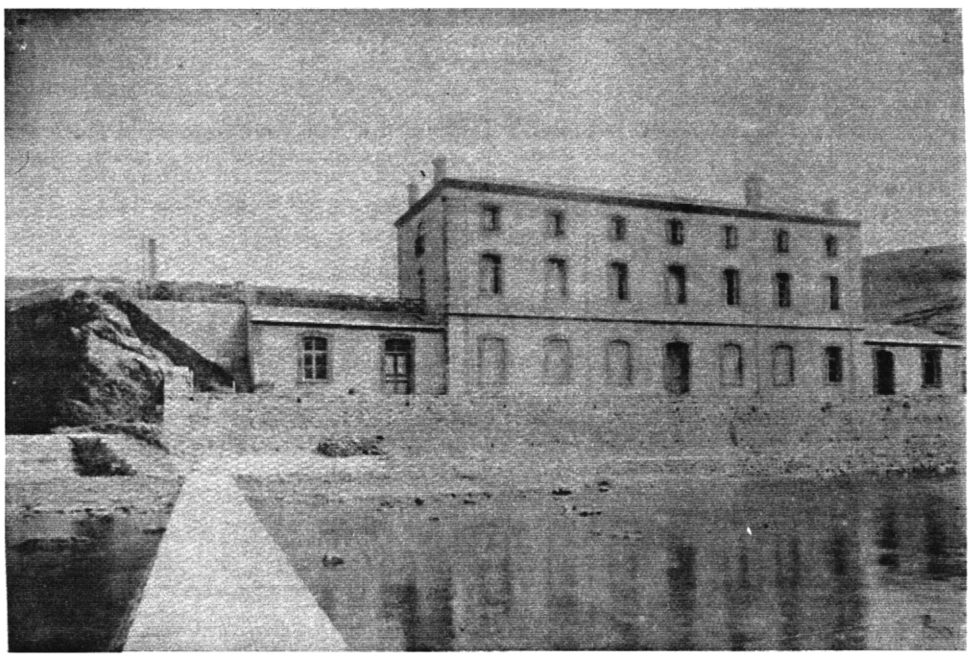


Fig. 5.9 (above) Arago Laboratory with Île Grosse in the background (ca. 1881). Fig. 5.10 (below) Arago Laboratory with auxiliary wings (ca. 1883). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

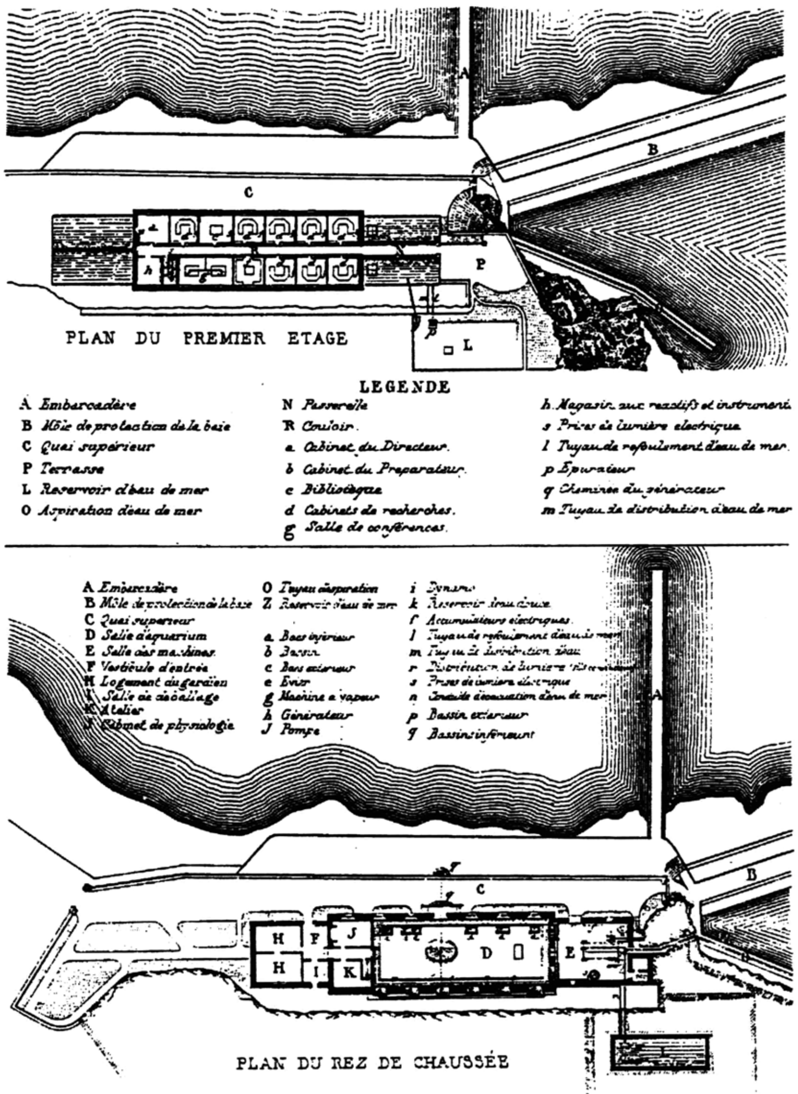
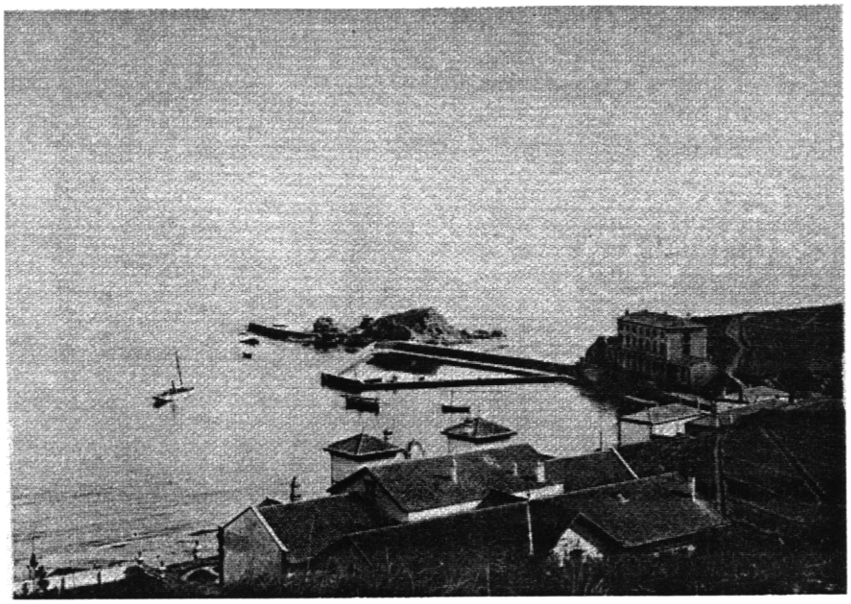


Fig. 5.11 Plan of Banyuls (1891). Henri de Lacaze-Duthiers, "Les Laboratoires Maritimes de Roscoff et de Banyuls en 1891," *Archives de Zoologie Expérimentale et Générale* t. 9, ser. 2 (1891), plate XIV.



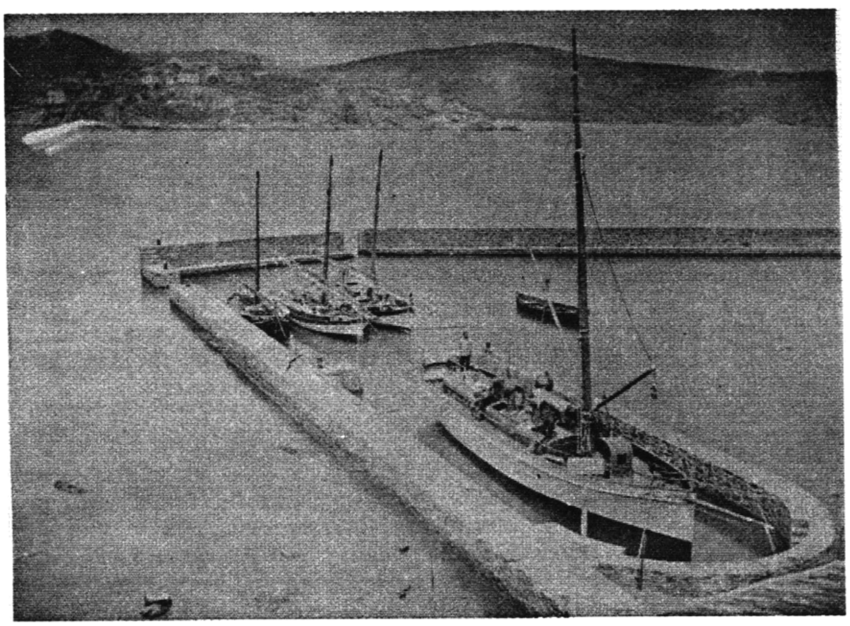


Fig. 5.12 (above) Arago Laboratory and viarium extending into the bay of Banyuls (ca. 1883). Fig. 5.13 (below) Vivarium and dry-dock of Banyuls s/m with the *Roland* (ca. 1890). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

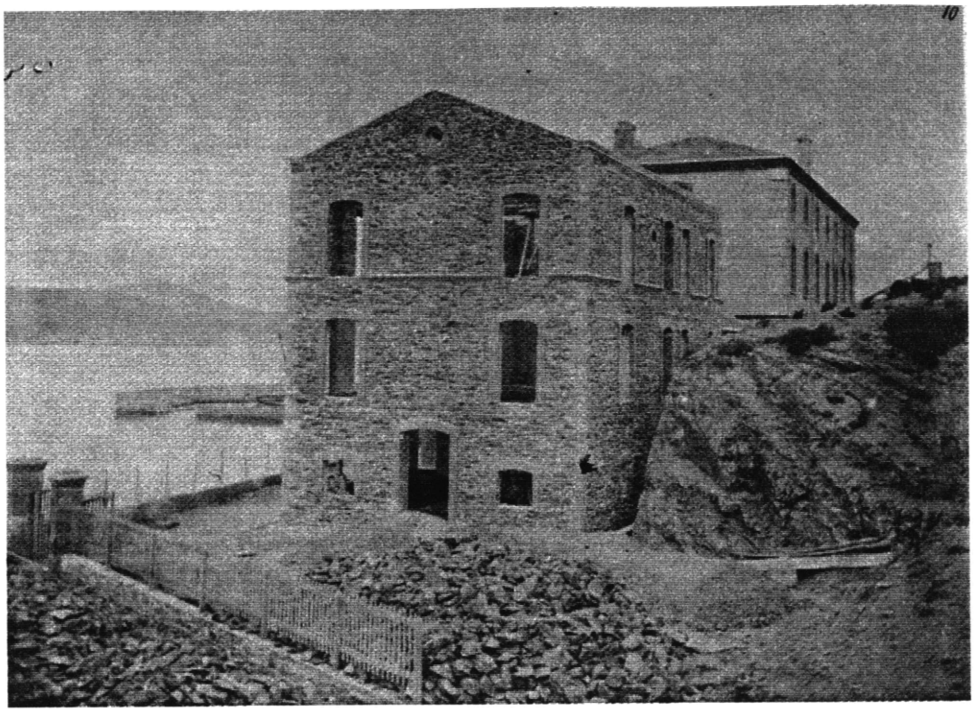
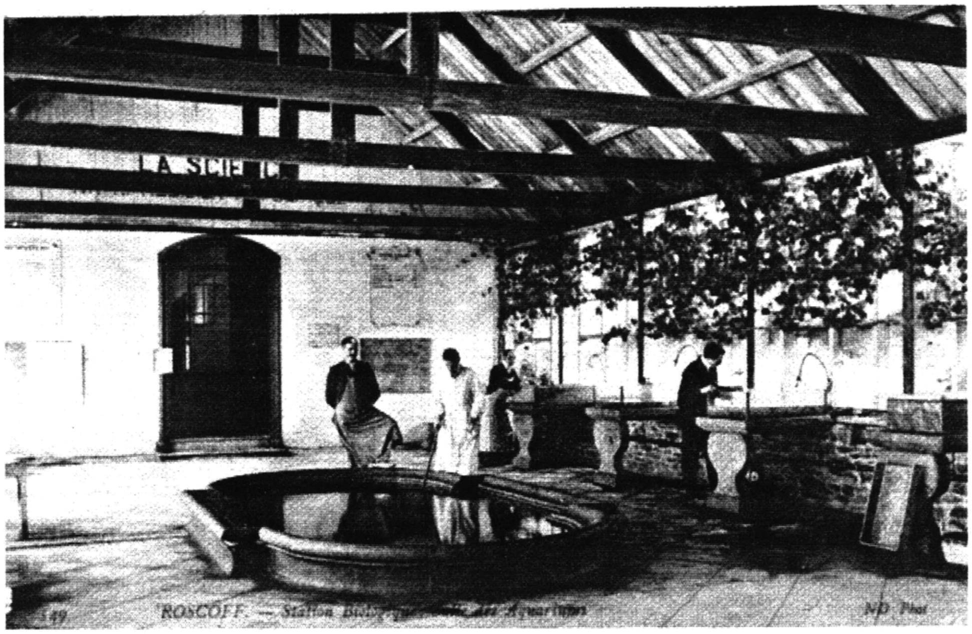


Fig. 5.14 Construction of annex of Banyuls s/m (1894). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.



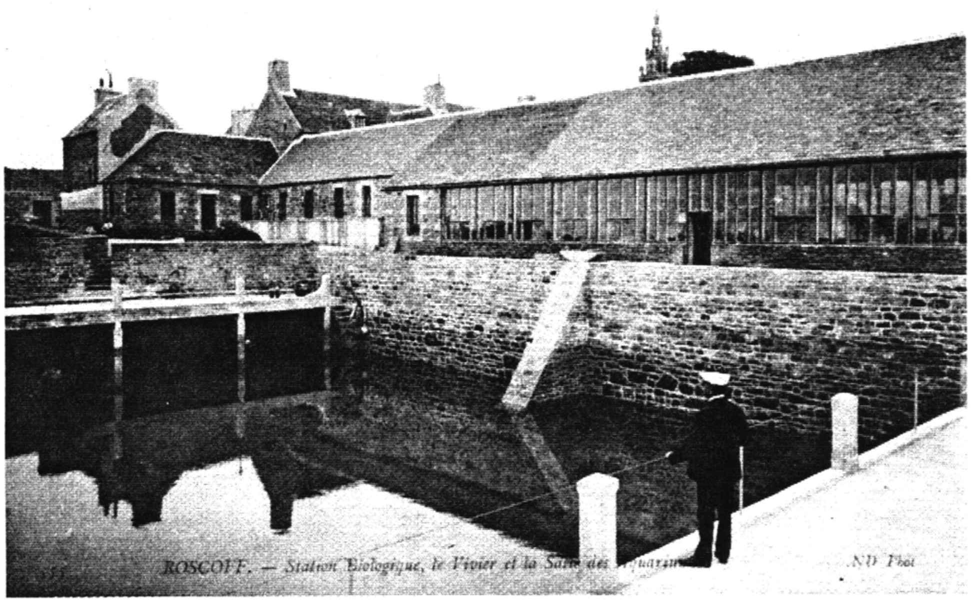


Fig. 5.15 (above) Laboratory of Roscoff, aquarium room. Fig. 5.16 (below) Vivarium with aquarium wing in the background (ca. 1890). Archives of the Station Biologique de Roscoff.

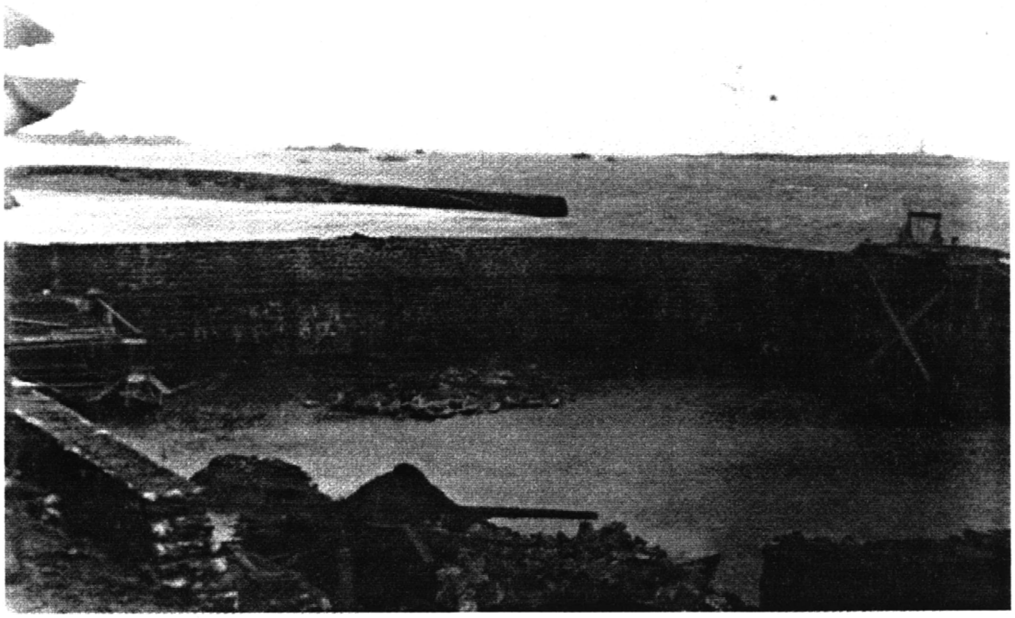
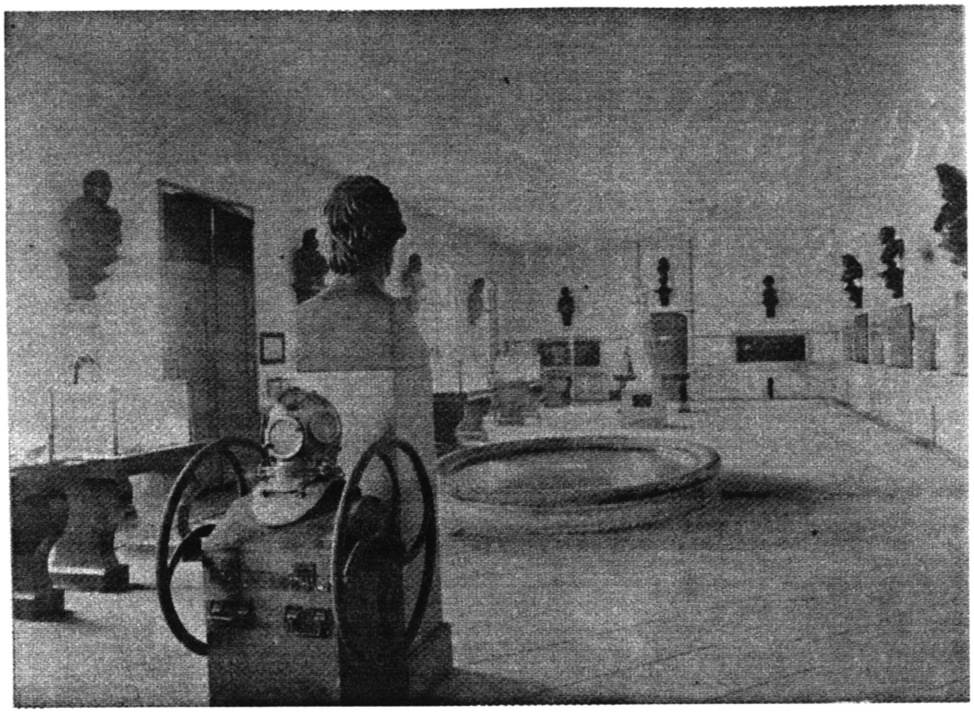


Fig. 5.17 Vivarium of the laboratory of Roscoff under construction. Archives of the Station Biologique de Roscoff.



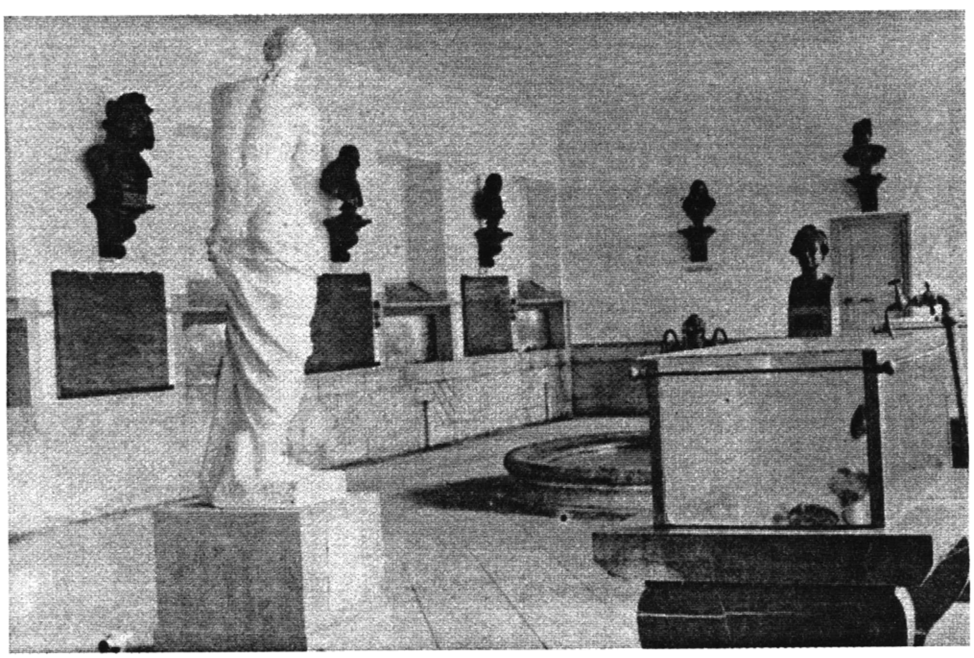
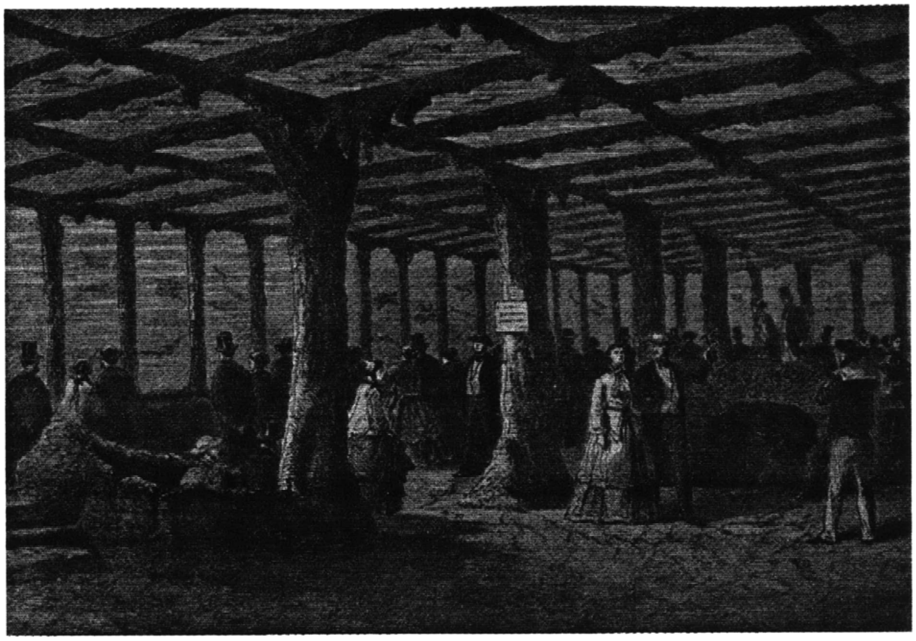


Fig. 5.18–19 Arago Laboratory, views of the aquarium room (ca. 1890). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.



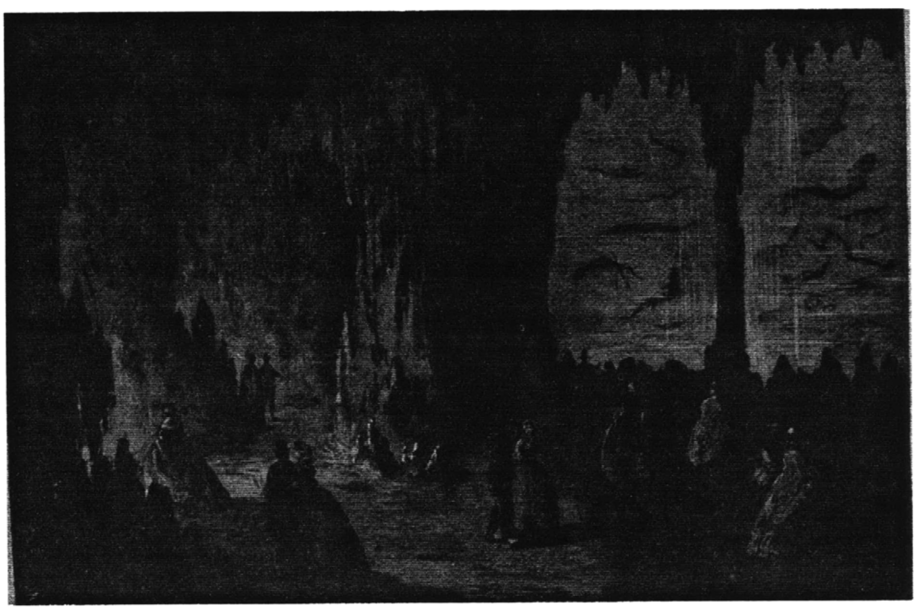
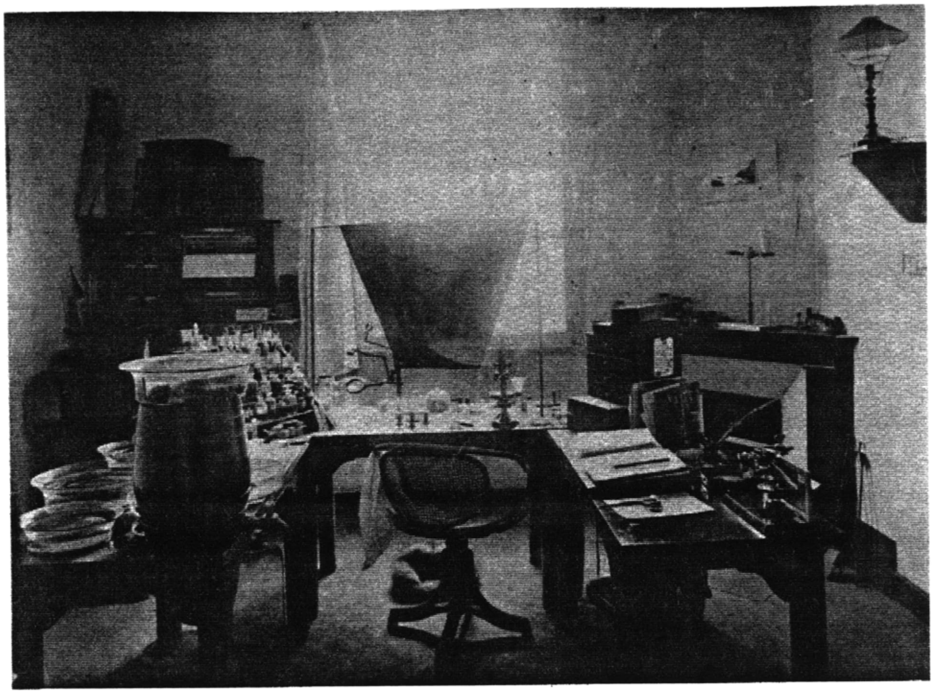


Fig. 5.20 (above) Interior of the fresh water aquarium at the Universal Exposition of 1867. Fig. 5.21 (below) Interior of the marine aquarium. Fr. Ducuing, ed., *L'Exposition Universelle de 1867* (Paris: Commission Impériale, 1867), V, pp. 76–77.



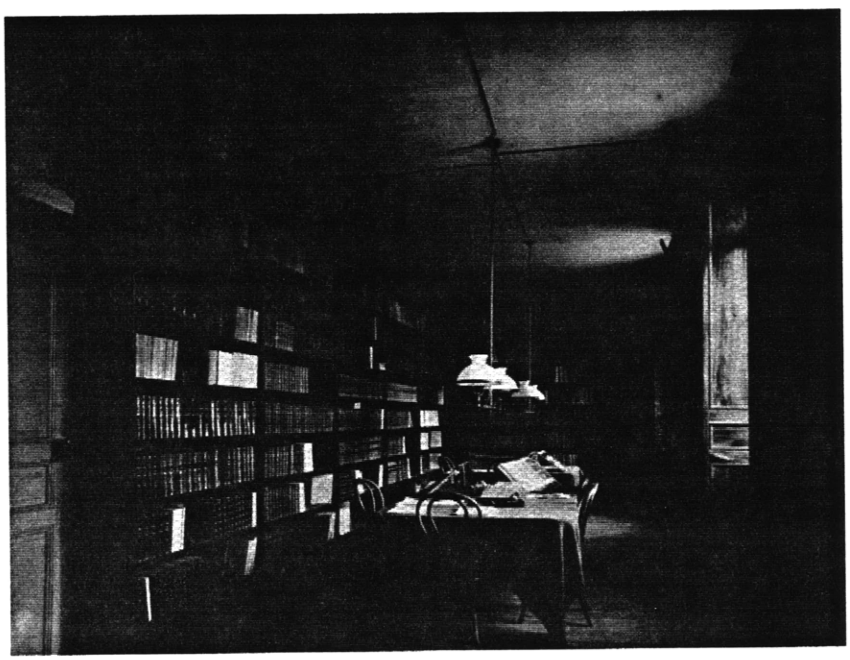


Fig. 5.22 (above) Arago Laboratory, research room with three-sided research desk and swivel chair. Fig. 5.23 (below) Arago Laboratory, library (ca. 1890). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

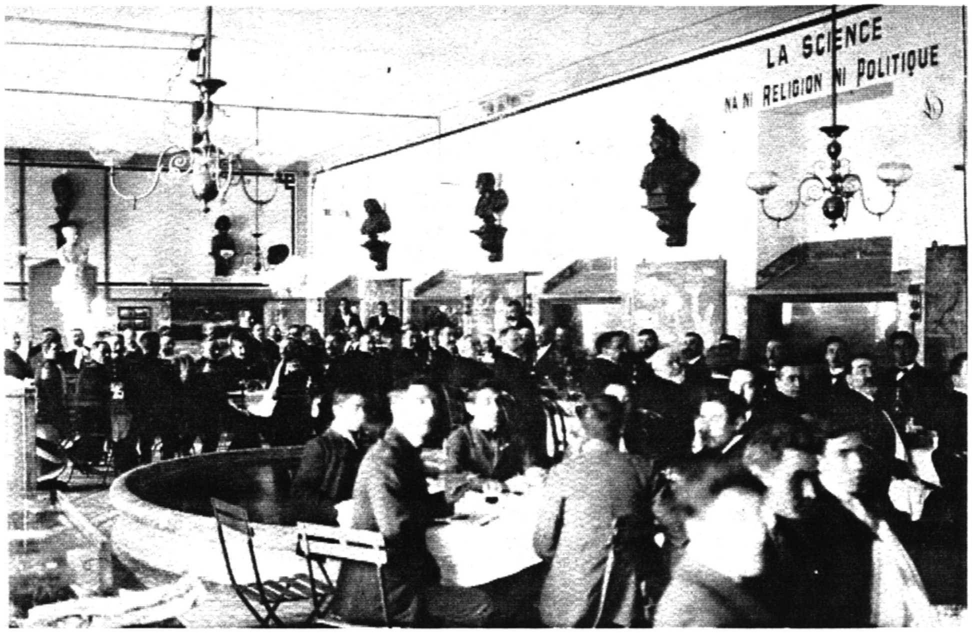


Fig. 6.1 Arago Laboratory, banquet in honor of Henri de Lacaze-Duthiers (1901). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.

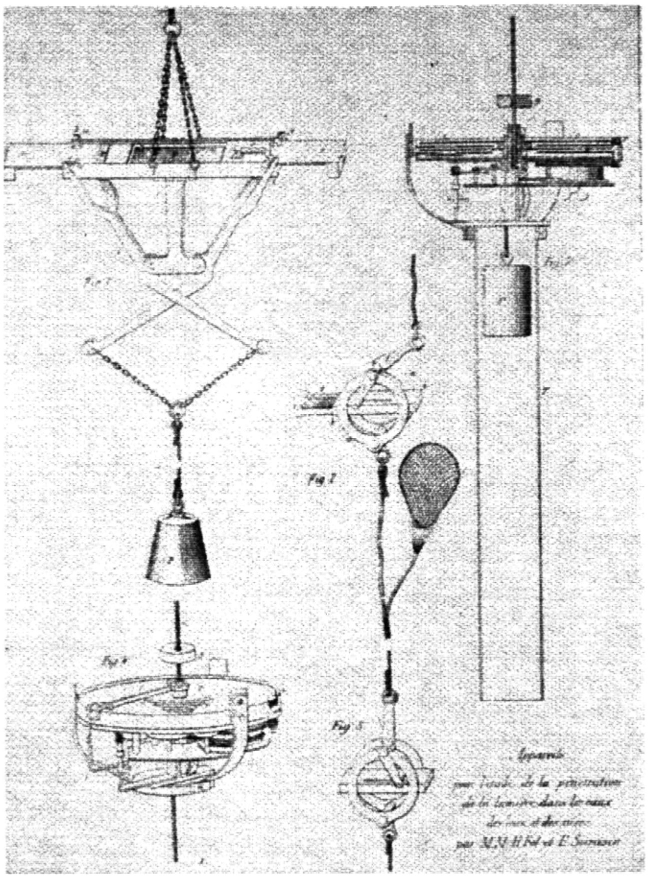
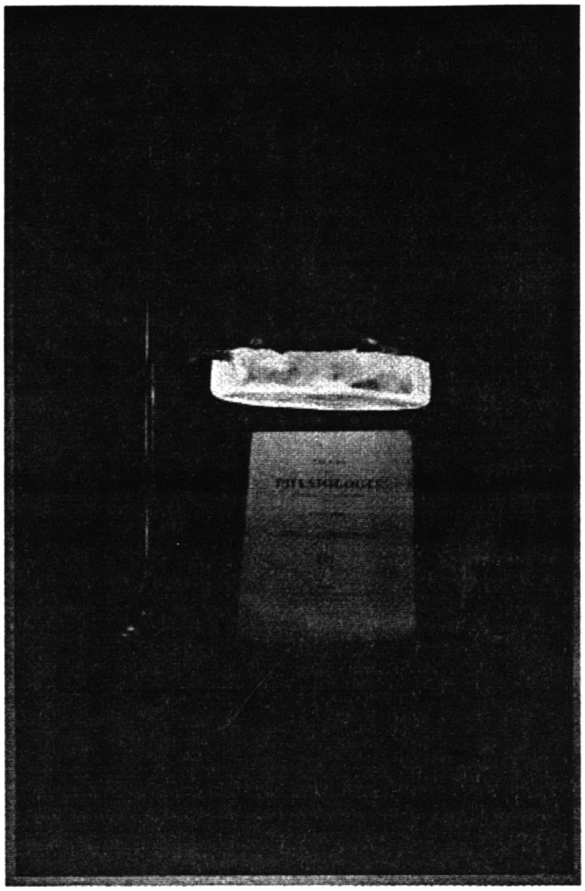


Fig. 6.1 Instruments used to study the penetration of light in the sea and lakes. Hermann Fol, Édouard Sarasin, "Pénétration de la Lumière du Jour dans les Eaux du Lac de Genève et dans celles de la Méditerranée," Mémoires de la Société de Physique et d'Histoire Naturelle de Genève t. XXIX, no. 13 (1887).



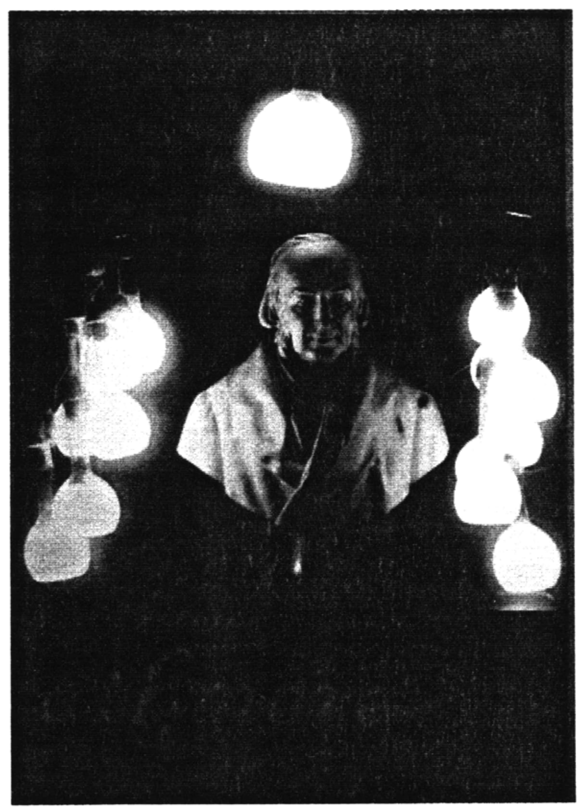
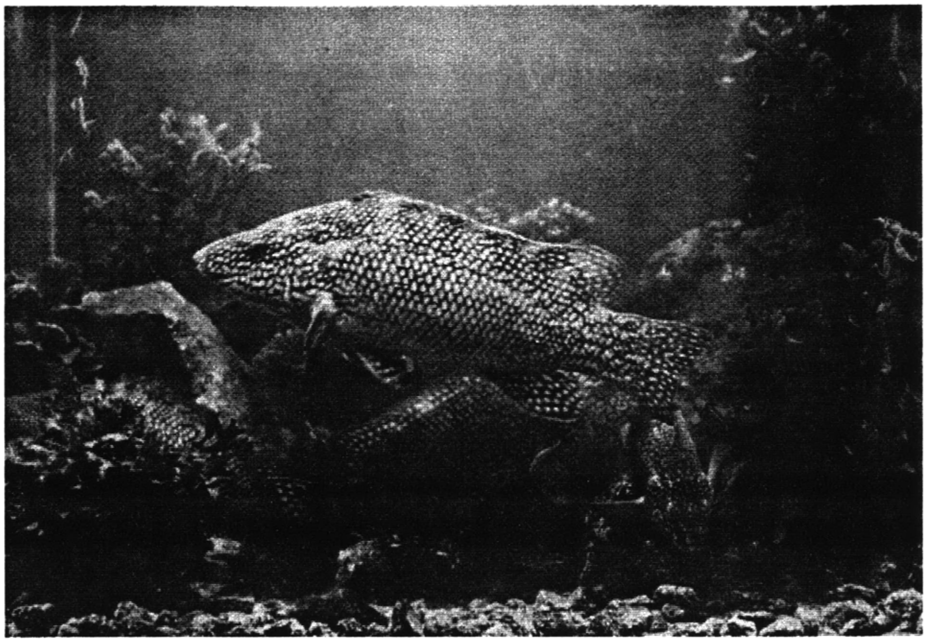
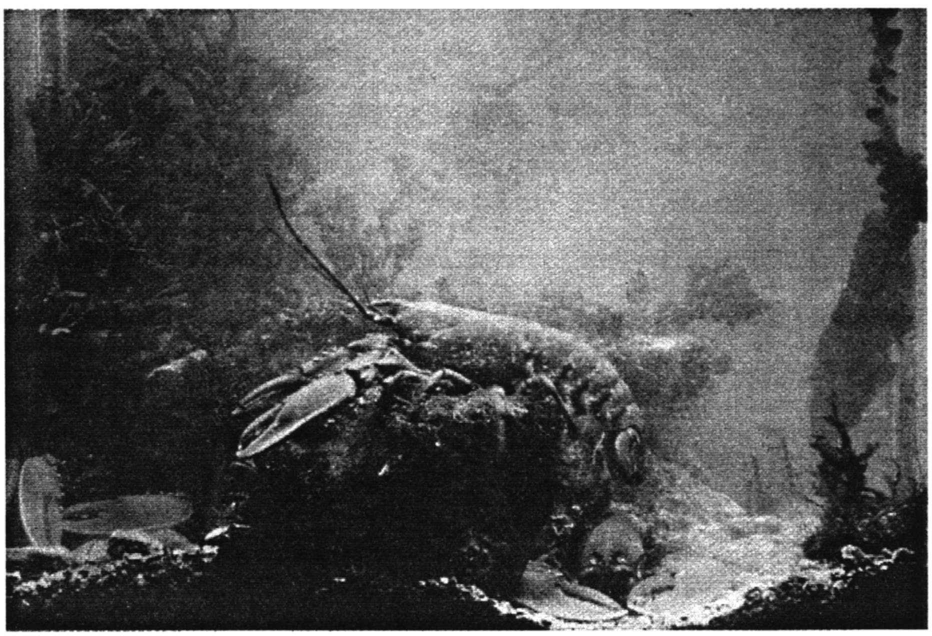


Fig. 6.2 (left) Raphael Dubois, photograph of his *Leçons de Physiologie* made using "living lamps." Fig. 6.3 (right) bust of Claude Bernard. Archives of the Station Maritime de Biologie à Tamaris.





Figs. 6. 4–5 Aquarium photographs. Paul-Louis Fabre-Domergue, *La Photographie des Animaux Aquatiques* (Paris: Georges Carré et C. Naud, 1899). Archives of the Station de Biologie Marine de Concarneau.

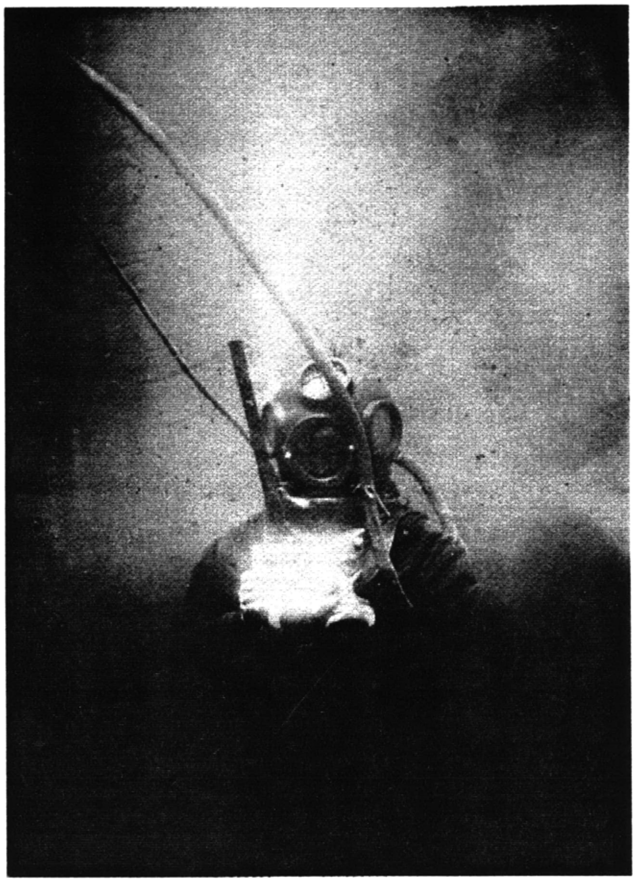
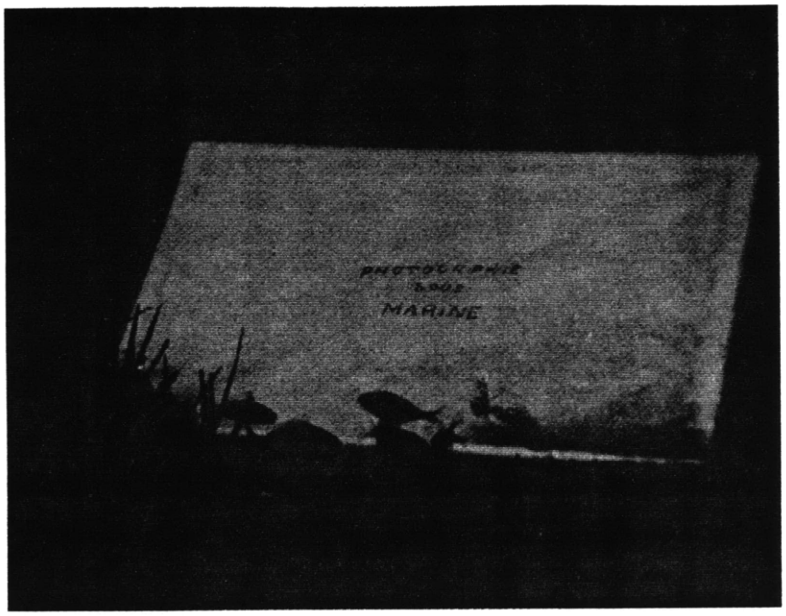


Fig. 6.6 (left) Louis Boutan, "Portrait of a Diver. " Archives Historiques de l'Observatoire de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie. Fig. 6.7 (right) "Underwater landscape, the Bay of Banyuls," Louis Boutan *La Photographie Sous-Marine* (Paris: Schleicher Frères, 1900).



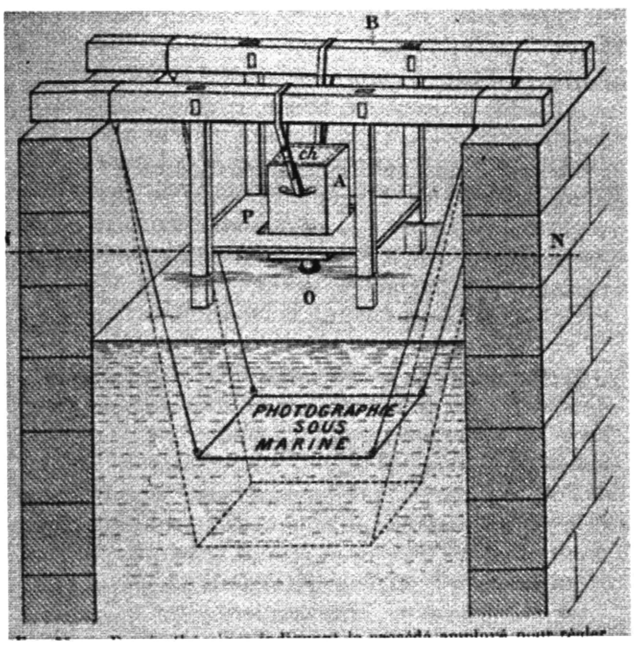


Fig. 6.8 (above) "Fish photographed in front of a white screen plunged to a depth of several meters." Fig. 6.9 (below) Diagram of process used to establish focal distance of underwater camera in the dry-dock of Banyuls s/m. Louis Boutan, *La Photographie Sous-Marine* (Paris: Schleicher Frères, 1900).

Fig. 6.10 Louis Boutan, study in underwater photography, Banyuls s/m (ca. 1900). Archives Historiques de l'Observatoire Océanographique de Banyuls, Laboratoire Arago, Université Pierre et Marie Curie.