SEA FISHERIES
THEIR
TREASURES AND TOILERS

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SEA FISHERIES

SEA FISHERIES

THEIR TREASURES AND TOILERS

By MARCEL A. HÉRUBEL

DOCTOR IN SCIENCE AND PROFESSOR
AT THE INSTITUT MARITIME

TRANSLATED BY
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CONTENTS

	PAGE
AUTHOR'S PREFACE TO THE ENGLISH EDITION	II
INTRODUCTION	15

PART I

THE FISH

CHAPTER I

EDIBLE SPECIES	21
--------------------------	----

I. Fish, thy name is legion!—Feeding and breeding in relation to migration—Current factors and hereditary instincts. II. Table of the principal species consumed in France. III. The geographical distribution of these species.

CHAPTER II

FISHING-GROUNDS	54
---------------------------	----

I. The continental plateau of the Atlantic ; the in-shore and off-shore districts ; the Channel. II. The threshold of the Mediterranean. III. The North Sea and the Dogger Bank. IV. The banks of Newfoundland. V. The banks of Iceland. VI. The Atlanto-Saharan or Morocco banks and the Baie du Lévrier (Bahia del Galgo).

CHAPTER III

THE OCEAN FEEDING-GROUNDS	70
-------------------------------------	----

I. The salinity and density of marine waters, in particular on the fishing-grounds. II. Oceanic circulation — The physiology of the North Atlantic, the Gulf Stream, and the

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Wyville Thomson ridge—The physiology of the North Sea. III. The tidal currents of the Channel—Vertical currents. IV. The physiology of the African Atlantic. V. Plankton—Composition and physiology. VI. Its distribution and functions in relation to ocean currents. VII. The conditions of the formation of plankton. VIII. Plankton as an accumulator of energy—The problem of the alimentation of marine species—The cycle of oceanic life—The hygiene of the seas.

CHAPTER IV

FACTORS OF DESTRUCTION 101

I. The depopulation of our native waters—The impoverishment of the North Sea. II. Natural causes of such depopulation: sudden migrations, modifications of the sea-bottom, voracious fish and mammals. III. The damage done by seines and drift-nets—The otter-trawl in relation to flat-fish and spawning-grounds. IV. The ox-net or Mediterranean bag-trawl and the shrimp-trawl—The small fishers responsible.

CHAPTER V

FISHERY LAWS 117

I. The territorial waters of the Hague Convention (1883)—The fisheries police in France and the decrees of 1853 and 1862. II. A curious attempt at protecting the nurseries in neutral waters: the English Parliament and the Moray Firth. III. Essential measures: universal interdiction along the coast of all destructive devices, and universal protection of territorial waters.

CHAPTER VI

REPOPULATION OF FISHING-GROUNDS 127

I. Reservations or *cantonnements*—Their utility. II. The movements of the "ground" species and the "marked fish" of St. Andrews Bay—Transplantations of plaice on the Dogger Bank. III. The plaice of Lüm fjord—The *valli* of Comacchio, the *valli* of Venetia, and the salt-water pools and lagoons of the French coast. IV. The fishponds of Arcachon and the "fish marshes" of Vendée—Their history, description, and use—The fish-ponds of the Atlantic coast and the shores of Languedoc. V. Conclusion.

CONTENTS

7

CHAPTER VII

	PAGE
FISHERY AND SCIENCE	148

I. Piscifecture—Its principle and methods—Criticism of its results—The laboratory of Flödwig. II. Azote in the economy of the ocean—The Conference of Stockholm (1899), and the Christiania programme (1901)—Theory and practice—Fishery charts. III. The fishery schools of the French coast—Professional and technical instruction—New fishing-grounds.

CHAPTER VIII

FISHERY PROBLEMS	165
----------------------------	-----

I. Local distribution of fish: movements and migrations are not extensive. II. The dependence of fish upon their surroundings—The herring of the Kattegat—Miraculous catches in the estuary of the Elbe. III. Comparative independence of fish—Defence and attack—Hereditary instincts. IV. Special adaptation—The critical oceanic condition and the critical biological condition—The law of fishing-grounds. V. Practical consequences of this law—Experiments of the Fishery Board of Scotland—Virgin grounds—Matters of exploitation—The fisheries of the future.

PART II

PRODUCTION

CHAPTER I

SOCIAL LIFE ON THE COAST	197
------------------------------------	-----

I. The *οικουμένη* of the coast—Antagonism between fishing ports and commercial ports—Historical pen view of the development of the Havre district. II. Principal professional and social groupings among the French fishermen—The necessity of an extension of the *οicumene*.

CHAPTER II

FISHING PORTS	205
-------------------------	-----

I. Generalities concerning the French fishing ports. II. Boulogne, Fécamp, Arcachon; Grimsby—Description of

these ports ; their equipment and their physiognomy. III. Hull, Yarmouth, Lowestoft, Aberdeen—Description of these ports—Esbjerg—Geestmünde—History of the latter : its organisation—Cuxhaven, Ijmuiden. IV. The French, English, and German administrative systems. V. Conclusion.

CHAPTER III

BOATS AND GEAR 224

I. The three-masted Newfoundlanders ; the Iceland schooners ; herring and tunny boats—Small sailing vessels : *étadiers*, feluccas, Biscayans, tartanes—Foreign sailing vessels—Various rigs. II. Steam trawlers—Line-fishing vessels—Drifters—Motor-boats ; pinnaces ; Scotch herring boats, &c. III. Classification of fishing tackle—The otter-trawl—The beam-trawl, the ox-net, bag-trawl, or *gangui* ; the seine or sean ; the herring fishery in Norway. IV. Drift-nets ; herring-nets—Fixed tackle : traps, eel-pots ; tunny-nets (*madragues*)—Baited devices ; the sardine-net of the Atlantic coast—Lines ; cod-fishing. V. Conclusion.

CHAPTER IV

THE FISHERMEN 244

I. The share system—Its mechanism—Boulogne, and its local complications : Fécamp. II. Fitting-out for the ocean fisheries—Modes of payment : by the fifth ; by the task ; by the quintal ; by shares ; by weekly or monthly wage. III. Summary—Wages at Boulogne and abroad. IV. Various forms of organisation among ocean-going fishermen ; insurance societies ; *Crédit Maritime*. V. Arbitration—The maritime inscripts and the State ; the Naval Pensioners' Fund (*Caisse des invalides de la marine*) ; the Prudential Fund (*Caisse de prévoyance*) ; the law of April 17, 1907.

CHAPTER V

THE PROFIT 262

I. The revenue of drift-nets, trawls, and lines in the North Sea, the Channel, the Atlantic, and the Mediterranean. II. The revenue of boats ; sailing boats and steamers

average productivity. III. The earnings of sailing vessels and steamers; economic sketch of the Boulogne district; the size-limit of steamers. IV. The earnings of fishermen in France and Great Britain—The yield per square mile of the principal fishing-grounds.

CHAPTER VI

THE FISHING NATIONS AND THE GREAT FISHERIES . . . 276

I. Scotland and England—Germany—Denmark, Holland and Belgium—Norway, Spain, and Portugal—Italy and Russia—Canada and Japan—France. II. The French cod fisheries—Steam-trawling off Newfoundland. III. The sardine fishery of Brittany; fishermen, bait-sellers, manufacturers. IV. The herring fishery; the mackerel fishery; the tunny fishery.

CHAPTER VII

THE EVOLUTION OF THE FRENCH FISHERIES . . . 294

I. History of the steam fishing-boat—Sail *versus* steam—The naval inscripts and the capitalists. II. The defence of steam; its triumph. III. History of the motor-boat as applied to fishery—Its progress abroad and in France—The old types of boats and motors—New types. IV. Alcohol or petrol?—The two principles criticised. V. The principal consequences of mechanical fishery. VI. The steam-trawling crisis.

CHAPTER VIII

THE MARKET 312

I. Various modes of sale: sale on board, sale by sample, sale by auction—The fish markets of Boulogne and La Rochelle. II. The taxes upon sales imposed by the municipalities—The *octroi* dues of the city of Havre. III. Critical examination of municipal taxes; their prohibitive nature; monopolisation of the sale of fish by the cities—The *octroi* dues of inland cities. IV. The increased retail prices of fish—Middlemen—Effectual remedies: producers' co-operative societies and companies.

CHAPTER IX

	PAGE
THE OUTLETS	325
<p>I. A glance at the railway transport of France. II. Railway tariffs in France and abroad ; the poor organisation of the French railways ; the principal grievances of the fishermen and forwarders. III. The consumption of fish in France ; imports and exports ; foreign competition in the sardine trade. IV. A few words concerning the market of Basle—Refrigerating cars—Billingsgate. V. The commercial vicissitudes of fish—Fresh fish : importations in Germany, Switzerland, Belgium, Austria—Preserved fish : importations of herring in Germany, Russia, and the United States ; of cod in Spain, Portugal, Italy, and Brazil.</p>	
CONCLUSION	345
PRINCIPAL FISHING GROUNDS	349
PRINCIPAL FISHING PORTS	350
BIBLIOGRAPHY	351
SUBJECT INDEX	359

AUTHOR'S PREFACE TO THE ENGLISH EDITION

THE English press has given my book a very flattering welcome, and I am glad to seize an opportunity of expressing my gratitude ; especially would I thank Mr. Stephen Reynolds, who stated, in the *Daily News*, his encouraging opinion that an English translation was called for. Finally I have to thank Mr. Fisher Unwin, who has taken the initiative in offering this translation to the English public.

It is true that I wrote for my compatriots ; wishing to advise them as to the development of ocean fisheries, to put them on guard against their mistakes, and to do my best to prepare a better future for them. But the model which I have held before their eyes, the country I advise them to imitate, is Great Britain. I will even say that it is enough to understand the history and the economy of the English fisheries in order to formulate the general rules of the industry. Such is the truth I have tried to establish contained in a few lines ; and in this light I would put before our friends across the Channel a book which was in fact written for them as well as for my countrymen.

The English have always had the faculty of uniting tradition and progress ; with them the things of yesterday and the things of to-day are not in perpetual conflict. Along the quays of Hull, Grimsby, and North Shields

12 PREFACE TO THE ENGLISH EDITION

are crowded the fine and powerful steam trawlers that ply to the distant fishing-grounds, while Lowestoft harbour is full of graceful sailing vessels. The former are devoted to ocean fishery on the grand scale; they work for the people of the Black Country, while the latter net the soles and "prime fish" of the North Sea for the tables of the wealthy. Aberdeen possesses not only a fleet of magnificent steam drifters, but sailing vessels as well. There is room for vessels of all classes in a harmonious whole.

The means are varied and the methods flexible. English shipowners have grasped the fact that eternal fertility cannot be expected of *the same* fishing-grounds. They have left the beaten paths in search of new pastures, and have found them. They ply the otter-trawl on the banks of Iceland; they trawl the almost virgin depths of the White Sea^{*}; they send their trawlers along the West Coast of Africa; in short, by continually extending their maritime domain they are able to give exhausted grounds the time necessary to their recovery; this bank recovers itself while that is newly exploited; then the latter is left in repose and the former resumed.

This method of alternate exploitation, which I have expounded in the following pages, constitutes the best means of ensuring a regular and constant supply. This is its least advantage; for, thanks to the elasticity of this supply, the method provokes the equipment of an ever-increasing number of vessels, which bring to port ever-increasing quantities of fish. The total catch of the fishermen of the British Isles amounts to 958,000 tons,

^{*} The Russian Government, by claiming a nine-mile territorial limit, has this year claimed the right to close the White Sea. There are, however, other excellent fishing-grounds in the Arctic Ocean.
—TRANS.

which represents more than £10,000,000. Each fisherman is responsible for nearly ten tons of fish a year, representing a value of £105, and his profits amount nearly to £61. These are excellent results, but they will soon be surpassed.

Excellent at sea, the English system is still more admirable on shore. The United Kingdom is equipped with great fishery ports, capacious harbours, whose only object and function is fishery. These ports are well situated and splendidly equipped, and are connected up with the rest of the country by means of numerous railways. The various operations are easily and rapidly effected. At Grimsby enormous shipments of fish—amounting to a thousand tons and more—are unloaded from a hundred trawlers as they lie moored in the Fish Dock, are sold by auction, loaded in three or four hundred trucks or vans, and despatched in all directions, all in the course of a few hours. In France the municipal *octroi* duties are imposed upon fish as though it were a luxury which could well afford to pay. Fish is loaded with taxes; but in England this valuable form of food finds the gates of every city open to it, or, rather, there are no gates. The English have long understood that the men of the seaboard are not foreigners, but of the same nation as the men of the cities, the mines, and the fields.

Not far from the market sheds are the ice factories and the warehouses of the fish merchants and the fish-curiers, and the factories where fish meal or fish manure or fish glue is made or fish-oil prepared; beyond these are the repairing shops, the ship-chandlers', the sailmakers', and ropemakers' warehouses. The life of these ports is active and concentrated. It is disciplined and orderly, thanks to the goodwill of all, and is supervised by a local

14 PREFACE TO THE ENGLISH EDITION

administration which is usually wise, competent, and liberal. The fishery companies and trawler companies are provided with ample capital ; for in England fishery is an industry, not a speculative investment.

This industry is based not only on the long experience of English fishermen, on economic tradition and unsleeping initiative, but also on the scientific organisation of the English fisheries. You have not been afraid to spend money on useful experiments, and have studied the biology of the principal marketable species, the question of the migration and the transplantation of fish, the value of reservations, and the efficiency of different forms of gear and tackle. You have also undertaken purely theoretical inquiries into the salinity and temperature of the seas, the nature of the ocean floor, &c.

Such is a synthesis of British fishery and of fishery in general. I have expounded it at length in the following chapters, and it has been a pleasant task to a sincere admirer of Great Britain.

MARCEL A. HÉRUBEL.

[It is perhaps hardly needful to explain that the above details refer to our great fishing-centres only ; the small fisherman in the small commercial port or watering-place is often far from prosperous, being at the mercy of a small close ring of buyers and an indifferent freight service. There are signs here and there of a tendency to co-operate with a view to obtaining petrol engines, which would enlarge the available radius of the vessels.—(TRANS.)]

INTRODUCTION

"The ocean is the seat of enduring power. So long as they held the sea the small States ruled the world : little Greece, Tyre, Amalfi, Pisa, Genoa, Venice, Portugal, Holland. . . . That Rome triumphed over Carthage, that she became the Roman Empire, was due to the fact that she won the sea from her enemy. The Spain of Charles V. fell miserably when she lost the mastery of the sea. Napoleon assembled Europe beneath his eagles, but he possessed nothing permanently, because the inexorable ocean remained in the hands of the English." *

So says M. de Vogüé : so might some ocean deity speak, patron god of Argonauts, in humour more didactic than Olympian ; and indeed the calling of his voice has been always heard by the active peoples who have loved and lived the strenuous life. Words of his are graven in letters of bronze upon British hearts ; they summoned Japan to battle and to victory ; they inspired in the Kaiser Wilhelm II. his famous motto : *Our future is on the water*. There was a time when the French were the favoured followers of the sailor's god ; but we have grown too quickly, and the Master of the Seas appears to us through the veil of years as an old surly pedagogue, remembered as immoderately given to setting impositions and bestowing raps upon the knuckles.

Yet the old sea-god, who now teaches other disciples, was a beneficent master, and his punishments were far less to be dreaded than our present oblivion of his salutary counsel.

* *Le Maître de la Mer*, by M. de Vogüé.

The stagnation, or rather the decadence of the French marine, is a matter of common knowledge. It is true that the Frenchman willingly slumbers and dreams of past glories; yet he has the faculty of waking promptly enough. But is it not perhaps too late? Should we prove to have the strength and courage to recover—

“The few steps lost by hundreds in advance”?

To the first question I answer, No! to the second, Yes! We must believe in success, for no work is other than sterile if conceived in despair. Let us go boldly forward.

In one of those delightful romances of his, in which the profoundest truths are found lurking behind a mask of paradox and humour, the illustrious Mr. H. G. Wells, describing the condition of human society many hundreds of centuries hence, supposes it divided into two classes only: the Morlocks and the Eloi. The Morlocks are industrious and labour without rest. The Eloi live without care, rather like a set of gods on strike, and enjoy an eternal repose. But woe to them if during the night they wander from their houses!—they are caught, killed, eaten by the Morlocks! . . . Well, we must not become Eloi.

The effort ahead of us will be stupendous, for the marine is a homogeneous body. Those of the Great Powers richest in ships of war and commerce are also those which possess the most numerous fishing-fleets. Many armoured vessels go with many liners, many tramps, many trawlers. Consider the case of Japan. Scarcely was the country re-born amid the thunder of the guns of Tsushima but she was launching steamers of heavy tonnage from her slips, and developing her fleets of fishing-boats. The fishing-boat and the merchant

steamer could not prosper without the ironclad. In reality these three elements are closely interdependent, but for the convenience of study we must consider each by itself.

In this book I shall deal with maritime fisheries.

By maritime fishery I mean the wholesale capture and distribution of fish as a common food-stuff. I have ignored all that concerns the capture or sale of edible shell-fish and crustaceans, such as oysters, mussels, lobsters, crayfish, and the industries of smoking, salting, and drying, as also such by-products as fish guano, fish-oil, isinglass, and fish-glue. We must begin at the beginning, that is, with the catching of fish, and the subject is vast enough to demand the minutest inquiry.

This book is not a treatise or text-book : by reading it you will learn neither how to catch fish nor how to sell them. I have endeavoured simply to produce a systematic study of the subject, by choosing, from the limbo of scattered material, those facts which are most important in the marine as in the economic domain. I have endeavoured to write, to the best of my ability, for the shipowner and the merchant, who, being absorbed in their own affairs, have not always the leisure to collate and digest the innumerable articles, books, and pamphlets dealing with the question. I have also endeavoured to write for the people who like to know something of everything. My principal aim, however, has been to call attention to the lamentable condition of our marine fisheries, and to seek the most efficacious remedies, with the aid of the persuasive examples of foreign countries.

I must express my gratitude to Professor Marcel Dubois for his inclusion of my book in his *Bibliothèque des Amis de la Marine*.

M. A. H.

PART I
THE FISH

SEA FISHERIES:

THEIR TREASURES AND TOILERS

CHAPTER I

EDIBLE SPECIES

I. Fish, thy name is legion!—Feeding and breeding in relation to migration—Current factors and hereditary instincts. II. Table of the principal species consumed in France. III. The geographical distribution of these species.

I

FISH, thy name is legion!

This apostrophe, whose vagueness I hope the reader will pardon, expresses a truth of pre-eminent significance in respect of the industry of maritime fishery. This is my excuse for setting it at the head of my first chapter, and thereupon devoting to it several lines of commentary.

The class of fishes comprises more than 180 families. Each family contains an average of twenty genera, and each genus five or six species. We thus arrive at a total of some 19,000 species, and there we must cry a halt, as to calculate the numbers of individuals would be impossible, even had we data to go upon; the numbers

would be too stupendous. For these creatures, placed at the bottom of the scale of vertebrate life, reproduce themselves with alarming facility. The turbot spawns 9,000,000 eggs in a season; the codfish, 6,000,000; the mackerel, 700,000; the herring, 50,000; the brill, 200,000; the red gurnard, 400,000; the sole, 85,000. Let us remark in passing, moreover, that the females are usually far more numerous than the males; the proportions are 75 to 25 in the case of the herring, and 95 to 5 in the case of the conger. Many eggs float on the surface of the sea;¹ in certain regions they are so abundant as to form a kind of living emulsion. In the Skagerack, on July 26, 1885, the Danish naturalist, Hensen, found fecundated eggs to the number of 278,795,000,000 to the square mile. During the months of February and March there are in the North Sea, according to Herr Krümmel, some 67,000,000,000,000 eggs and larvæ. If we admit that the same sea gives asylum each year to some 15,000,000,000 individual herrings, and that of 10,000 eggs only one results in an adult fish, the annual production of eggs would amount to 150 trillions. Fish,

¹ These are called pelagic eggs or spawn, in contradistinction to the submerged eggs, which fall to the bottom of the sea. The first are always very small, seldom more than one millimetre in diameter. The second are larger, being five or six millimetres in diameter. The eggs of the ray are enormous, and are protected by a tough rectangular case, or shell, with four horns or tendrils [the object which children know as one of the forms of the "mermaid's purse"]. Among the pelagic eggs we must cite (floating near the bottom) those of the thwaite shad; and floating at or near the surface those of flat-fish in general, of the cod, the grey and the red mullet, the haddock, mackerel, horse mackerel, gurnard, sea-perch, bass, and pilchard. The submerged eggs are those of the salmon, herring, and tunny families. The eggs are nearly always left to their fate. The sexes are separate, except in the case of some of the perches. Accidental hermaphroditism is found in the sturgeon, mackerel, cod, whiting, sole, and herring.

therefore, are practically innumerable and incalculable both in time and space, since the adult fish represents the present and the egg the future.

The first problem to be solved by these gigantic cohorts is the discovery of food. It must be abundant, for their jaws are innumerable; it must be substantial, for they are voracious. Look closely at a tunny, a mackerel, a hake. The long, compressed body indicates strength and speed; a fish is nothing but a bundle of powerful muscles, whose work demands an enormous expenditure of energy, or, in other words, almost continuous alimentation. The fact is that in the open sea a thousand dangers beset the fish, and as it is shortsighted on account of the spherical crystalline lens of the eye, which limits the accommodation of the sight to a dozen yards, it can only escape by means of its strength and the rapidity of its caudal appendage.¹

¹ The means of attack of the fish, in addition to its rapidity of movement, consist of its mobile jaws and its teeth, which are generally soldered to the bone or fixed in the mucous membrane of the mouth. The means of defence are flight, the production of venomous integumentary secretions, the use of the teeth or of spines, and mimetic colouring, as in the flat-fish, the pattern of the back resembling the ground on which they swim, etc. [All fish, like nearly all animals, have assumed a protective colouring or shading, in that they are dark on the back and light on the belly, so that when seen sideways with the light falling from above they are scarcely visible at any distance, appearing as flat shadows. If a shoal of gregarious fish be carefully watched it will be seen that as they turn some of the fish will make sudden rushes, turning over as they do so, when the flash of the belly is very conspicuous. This manœuvre is manifestly of use in keeping the shoal together.—TRANS.] The fry of the sole and the young sole often swallow prey considerably longer than themselves. [The young sole has an enormous stomach, the remains of the yolk-sac.] "The complete deglutition often lasts more than an hour, and while watching from the bows of the ferry-boat the soles passing to and fro constantly presented, as undeniable evidence of their appetite, the more or less prominent

Voracity is not the mother of repose. It is obvious that the herring, in whose stomach Professor Möbius has observed 60,000 minute crustaceans, and the pilchard, which will absorb as many as 20,000,000 microscopic algæ, must have travelled considerably to obtain such a meal. But to the voracity of the fish we must add another cause of locomotion : the necessity of spawning. Fundamentally the latter is the direct consequence of the former, as may readily be demonstrated. Let us suppose, for example, that the females do not eat before and during the process of spawning ; we have a period of abnormal abstinence, which naturally results in a corresponding period of compensatory voracity. It is by no means rash to deduce the past from the present and to arrive at this very reasonable hypothesis. Formerly, exhausted by spawning, the fish went in search of waters particularly rich in nutritive material. Those who could not reach them died ; the rest survived. Thus there is a fortuitous relation between the two phenomena of spawning and travel ; a close connection which by means of natural selection is transformed into a hereditary instinct affecting every individual of the species. From this we can understand that in the course of ages the two phenomena became simultaneous, or, if we prefer to say so, superimposed ; and we can understand, too, that the second phenomenon, by reason of its congenital character, might take the place of the first. This, as a matter of fact, does occur. In Canada the smelt spawns in the spring, but it begins to mount the

tails of their victims. . . . Gradually the whole body of the prey would disappear into the stomach as the interior portions were digested. . . . The functional power of the stomach and the organs of digestion soon rid the sole of the embarrassment of his voluminous abdominal pouch " (Fabre Domergue et Biétrix).

rivers as early as the end of December. The same is true of the sturgeon. The shoals of herring begin to move before the spawning season. The herring, indeed, often exhibits a double displacement, making one journey before and one after spawning. Thus the winter herring of the Boulogne fishery goes to spawn in the neighbourhood of estuaries and shoals. The young are already mingled with the *gai* or clean herring (fish whose ovaries are empty) when the arrival of a microscopic alga, the *Phæosphorus* of Pouchet, is followed by innumerable swarms of other clean herring, which in their turn enter the estuaries.

The term "migration" is used to denote the movement at the time of spawning of a whole species in a particular direction and at an almost constant date.¹

Mr. Edward E. Prince, of Ottawa, has published some excellent volumes dealing with the subject. Hardly has it issued from the egg when the fish first migrates. It travels from the west towards the deep bottoms or the open sea, and its movements are as invariable as the migrations of birds of passage. The ocean currents have no effect on the fry of the cod, the whiting, and the haddock; after they have emerged from their first larval stages they invariably make for the deeps, and only return to the coast when their ovaries are filled. It is the same with flat-fish. It will be seen that vertical displacements are the rule; ² and the existence of local varieties indicates

¹ Sturgeon, salmon, sea-trout, Seine smelts, flounders, and shad run up rivers to spawn. Eels, on the contrary, descend to the sea. Dabs and plaice, and even soles, travel great distances up-river.

² The expression "vertical displacement" must not be taken literally. It simply denotes a general tendency. Thus the pelagic larvæ born of the floating eggs of the sole make for the open sea. After the lapse of a certain period they return to the coast, and having become adult, resort to sandy bottoms at a depth of from

that such migrations are limited. The salmon of the Fraser River differ from those of the Nimpkish, although the two localities are only some forty to fifty miles apart. The fish always follow the same route. The Fraser River salmon travel along the Strait of San-Juan-de-Fuca. But in spite of the length of the route, and although there are excellent spawning-grounds in the rivers of Vancouver Island, they never depart from their secular habits. In the Nicola Valley (Western Canada) is a river divided into two arms by an island. A dam was built across the left arm, where the salmon were accustomed to pass. They had only to make a turn to the right to reach the upper waters of the river. They never did so ! The eels of the Landes, on the other hand, leave their ponds and brooks and gain the sea at any cost. They wait for a starless night, when the wind is blowing a gale. Nothing stops them on their journey seaward. If an obstacle confronts them they leave the water, crawl over the dunes, and wriggle through the grass and heather. Codfish always swarm off the coasts of Newfoundland and Iceland in winter. The sardine, more capricious perhaps—the word will serve to conceal our ignorance—always appears in summer in the French waters of the Atlantic. And when in the last days of January the shoals of herring leave the coast of Normandy to plunge into the depths of the sea, the Norman fishers know that they will return in the autumn as punctually as by appointment. Such is the impetuous and invincible force of hereditary instinct.

I have given these facts in detail because they help to support a thesis which I shall presently develop, and will also enable me to formulate a general theory of fishery.

ten to twenty fathoms, where they mingle with their relatives of preceding generations. This is true of all flat-fish.

II

The characteristic of the fish, as we saw at the outset, is its multitudinous numbers. Directed by this clue, we are able to appreciate the significance of the relations existing between feeding and breeding, displacement and migration. Fish are beyond enumeration: they are voracious: they spawn at nearly fixed periods: they are subject to closely limited local migrations, which are the work of a hereditary instinct. Moreover—and this is a factor not to be dismissed with contempt¹—they are shortsighted. It is evident that as a result of these factors it is possible for man, with the aid of appropriate engines, to exploit the seas, if not with scientific certainty at least with facility.

We must now name and place in order the principal edible species. On the following pages will be found a practically complete tabulation of the salt-water fishes consumed in France and England. I include all fish caught by French boats, whether on the French coasts, in the North Sea, off Newfoundland and Iceland, or along the shores of Spain and Portugal as far as the coast of Morocco. All are not of equal utility. The sardine is mentioned in company with the flying-fish, the cod with the atherine, and the herring with the gar-fish.

Last summer the fishermen of La Rochelle caught large quantities of horse-mackerel, which they returned to the sea. I have nevertheless entered this fish as one of the widely eaten species. The first fourteen species have cartilaginous skeletons: the others are bony fish. As for

¹ *Allgemeine Fischerie Zeitung*, 22, 1902. The fishermen of Havre state that the mackerel taken by the lines are blind, and they also assert that their eyes are covered with a film. I have searched for the latter in vain. As for the sole, Cunningham has demonstrated that it is almost completely blind.

the regional designations, I have chosen those best known. They are arranged everywhere in the same order, from the North Sea to the Atlantic and from the Atlantic to the Mediterranean. The importance of knowing the season of spawning is obvious, since it usually corresponds with the season of migration.

III

Thanks to this table, we can give the precise geographical distribution of the French species. First we will place those which are peculiar to one of the four seas which wash the coasts of France. We will divide the Atlantic into two portions ; one lying between the mouth of the Channel and the estuary of the Loire ; the other bathing the coast of Vendée and Charente and southwards to the Spanish frontier. Then follow the names of the species common to several seas.

Species chiefly peculiar to the—

North Sea.—1. Halibut.

North Atlantic.—2. Mary-sole.

South Atlantic.—5. Shark (No. 6), *Sciæna ombrina*, dwarf sole, Mary-sole, *Sole-sêteau*.

Mediterranean. — 27. Bordered ray ; *Uranoscopus* ; *rascasse* ; *Serranus scriba* ; *Serran hepatus* ; *Thynnus pelamys* (bonito, dolphin) ; Spanish mackerel, bream (Nos. 47, 48, 49, 51), green wrass, peacock wrass, peacock girella, *Chromis castanea*, sand-eel (No. 69), atherines (Riquet's and No. 72), golden mullet (*Mugil auralus*), *Mugil chelo*, Klein's sole, eyed sole, myroconger, *muræna*, *Muræna unicolor*, *Muræna sorcière*, *poulina*.

Species common to several seas—

Channel, North Sea.—4. Smelt, cod, ling, fluke.

Channel, North Atlantic.—4. Wrass (*L. bergylla*), salmon, lesser sand-eel, greater sand-eel.

North Sea, Atlantic.—1. Smear-dab.

North Sea, Channel, North Atlantic.—10. Salmon-trout, haddock, pout, whiting, pollack, coalfish, dab, flounder, herring, sprat.

FIG. 1.—Distribution of marketable species. The lines running from one sea to another denote the number of species common to these seas. The figures enclosed in circles denote the number of species peculiar to each sea.

Channel, North Atlantic, South Atlantic.—4. Sturgeon, white tunny, atherine (*A. presbyter*), brill.

South Atlantic, Mediterranean.—11. Piper, *Scorpaena scrota*, ombrina, tunny, bream (*P. centrodonatus* and *vulgaris*, *Sargus vulgaris*), *Crenilabrus massa*, common girella, thick-lipped mullet, *Centriscus scolopax* (bellows fish).

North Atlantic, South Atlantic, Mediterranean.—4. Lamprey, centrophorus, hake, burbot.

Channel, North Atlantic, South Atlantic, Mediterranean.—29. Larger spotted dogfish, lesser spotted dogfish, shark (No. 5), monk-fish, thorn-back-ray, common skate, white ray, sting-ray, weever, blenny, red mullet, surmullet, *malarmat*, Block's gurnard, *Cottus scorpius* (miller's-thumb), bass (Nos. 31, 32), bream, meagre, horse-mackerel, John Dory, gilt-head (*Box vulgaris*, *P. erythrinus*, *C. griseus*), grey mullet (*M. cephalus*), grey mullet (*M. capito*), plaice, lemon sole, pilchard.

North Sea, Channel, South Atlantic, Mediterranean.—15. Homely-ray, fishing-frog, red gurnard, grey gurnard, streaked gurnard, sapphirine gurnard, mackerel, common sole, turbot, anchovy, shad, thwaite shad, flying-fish, conger, eel.

The appended diagram (Fig. 1) is a graphic representation of the above facts. The lines running from one sea to another denote the number of species common to those seas; their thickness being in proportion to the number which they express. As we see, the distribution of marketable species along the coasts of France is almost homogeneous, for in spite of its twenty-seven peculiar species the Mediterranean presents close affinities with the southern and even with the northern portion of the North Atlantic (which portions I have for convenience spoken of as the North and South Atlantic), and these affinities are not wholly absent in the case of the colder waters of the Channel and the North Sea.

THE PRINCIPAL MARKETABLE SPECIES OF FISH

(SEA FISH EATEN IN FRANCE AND TAKEN BY FRENCH FISHERMEN, EITHER IN FRENCH TERRITORIAL WATERS OR ELSEWHERE)

(Names in brackets are of fish not given in *M. Hérubel's list of French species*)²

No	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
1	Cyclostomata (Petromyzontidæ) (Lampreys)	Lamprey <i>Petromyzon marinus</i> (Small Lampern or Pride) <i>P. branchialis</i>	<i>Lamproie.</i>	Spring "	Coast, rivers in spring " "	Atlantic, Mediterranean British seas and rivers
2	Scylliidae (Dogfish)	Larger Spotted Dogfish <i>Scyllium canicula</i>	<i>Grande Roussette, Rousse</i>	March- April	Coast and deep waters (rocks, pebbles)	Channel, Atlantic, Mediterranean

This list contains a few species not given in the original, but common to British waters. The species numbered form the original list.

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Names.			
3	Scylliidae (Dogfish)	Lesser Spotted Dogfish <i>Scyllium catulus</i>	<i>Roussette</i> , <i>Petite Roussette à grandes taches</i>	March-April	Coast and deep waters (rocks, pebbles)	Channel, Atlantic, Mediterranean
	"	(Spiny Dogfishes)		"	Coast	Channel, Atlantic
4	Sharks of various sub-families	<i>Centrophorus</i>	<i>Centrophore</i>	"	Coast, in deep water	Atlantic, Mediterranean
5	"		<i>Lamie</i> , <i>Squale-nez</i>	May and November	Deep water; coast between May and November	Channel, Atlantic, Mediterranean
6	"		<i>Emissole</i> , <i>Lentillat</i> , <i>Touilh</i>	"	"	Atlantic
	Lamnidae (Sharks)	(Basking Shark)	<i>Pélerin</i>		Surface and near coast (gregarious)	North Atlantic, Channel
7	Rhinidae	Angelfish, Monkfish <i>Squatina angelus</i> (A Shark, but resembling the Rays)	<i>Ange</i> , <i>Angelot</i>	May and November (Viviparous)	Deep water (sand)	Channel, Atlantic, Mediterranean

8	Raiidæ (Rays)	Thornback Ray <i>R. clavata</i>	<i>Raie bouclée</i>	Spring	Coast (sand)	Channel, Atlantic, Mediterranean
9	"	Common Skate <i>R. batis</i>	<i>Raie commune, cendrée, Pelouza, Rat de mer</i>	"	Coast (sand and near rocks)	"
	"	(Starry Ray) <i>R. radiata</i>		"	Coast (sand)	"
10	"	White Ray <i>R. alba</i>	<i>Raie blanche Raie à nez pointu</i>	"	"	"
	"	(Sandy Ray) <i>R. circularis</i>		"	"	"
11	"	Homelyn or Spotted Ray <i>R. maculata</i>		"	"	"
12	"	Burton Skate <i>R. marginata</i>	<i>Raie bordée, Miraillet</i>	"	"	"
	"	(Shagreen Skate) <i>R. fullonica</i>		"	"	"
13	Trygonidæ (Sting Rays)	Sting Ray <i>Trygon pastinaca</i>	<i>Trygon, Pastinage</i>	"	"	"

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
	Myliobatidæ (Devilfish)	(Eagle Ray or Devilfish) <i>Myliobatis aquila</i>		(Viviparous)	Coast, sand, also surface	Atlantic, Mediterranean
14	Ganoidei (Sturgeons)	Sturgeon (<i>Acipenser sturio</i>)	<i>Esturgeon</i>	Spring	Runs up rivers	Atlantic, Channel
15	Trachinidæ (Weevers)	Weever <i>T. draco</i>	<i>Vive, Lièvre, Chaquedit</i>	July	Open sea and coast (sand)	Atlantic, Channel, Mediterranean
	"	(Lesser Weever) <i>T. vipera</i>		"	" "	"
16	"	Star-gazer <i>Uranoscopus scaber</i>	<i>Rascasse blanche</i>	"	Open sea and coast (sand and sometimes mud)	Mediterranean
17	Blennidæ (Blennies)	Blenny <i>B. gatliffi</i>	<i>Bavarello, Cabot</i>	"	Coast (rocks and weeds)	Channel, Atlantic, Mediterranean
	"	(Shanny) <i>B. pholis</i>		"	" "	"
	"	(Sea-wolf, sea-cat) <i>Anarrhichas lupus</i>			Coast and open sea	Northern seas, Iceland and Greenland Banks

18	Pediculati (Fishing-frogs)	Fishing-frog, Angler-fish, Devilfish, Sea- devil <i>Lophius piscatorius</i>	<i>Baudroie, Diable de mer</i>	July	Coast, open sea, sand (20 to 40 fathoms)	North Sea (north of Dogger Bank), Channel, Atlantic, Mediterranean
19	Mullidæ (Mullet)	Red Mullet <i>Mullus barbatus</i>	<i>Vrai-rouget, Rouget-barbet, Barbarin</i>	Summer	Deep water (winter), coast (sand, mud, &c.) in summer	Channel, Atlantic, Mediterranean
20		Surmullet <i>M. surmuletus</i>	<i>Rouge, Faux- rouget, Rouget- barbet, Barbeau</i>	Spring	Coast (sand, mud)	" "
21	Triglidæ (Gurnards)	<i>Peristedion cataphractum</i>	<i>Malarmat</i>	Spring	Deep water (sand, mud), coast in spring	" "
22	"	Red Gurnard <i>T. pini</i>	<i>Grondin rouge Faux-rouget</i>	Summer	Deep water and coast (sand and rocks); coast in summer	North Sea, Channel, Atlantic, Mediterranean
23	"	Streaked Gurnard <i>T. imbricato</i> , also <i>T. lineata</i>	<i>Camard, Belugan</i>	"	" "	" "

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
24	Triglidae (Gurnards)	Grey Gurnard <i>T. gurnardus</i>	<i>Grondin gris</i>	Summer	Deep water and coast (sand and rocks); coast in summer	North Sea, Channel, Atlantic, Mediterranean
25	"	Piper Gurnard <i>T. lyra</i>	<i>Trigle lyra</i> , <i>Gallina</i> , <i>Cardinal</i> , <i>Bourreau</i>	"	" "	Bay of Biscay, Mediterranean (rarer north)
26	"	Sapphire Gurnard <i>T. hirundo</i>	<i>Trigle hirondelle</i> , <i>Perlon</i> , <i>Galline</i> , <i>Corbeau</i>	"	Deep water and coast (sand and rocks); coast in summer	North Sea, Channel, Atlantic, Mediterranean
27	"	Bloch's Gurnard <i>T. cuculus</i>	Cuckoo-gurnard <i>Trigle coucou</i>	"	" "	Channel, Atlantic, Mediterranean
	"	(Long-finned Gurnard) <i>T. obscura</i>				" "
28	Cottidae (Miller's Thumbs or Bull's Heads)	Bull's Head <i>Cottus scorpius</i>	<i>Cotte-scorpion</i> , <i>Chaboisseau</i>	November-February	Coast (sand, rocks, mud); builds nest	" "
29	"	<i>Scorpaena scrofa</i>	<i>Fausse-rascasse</i>	"	Ocean banks, rocks, weed	Bay of Biscay, Mediterranean

30	"	<i>Scorpaena porcus</i>	Scorpène-rascasse	"	Coast (sand, mud, fishponds)	Channel, Atlantic, Mediterranean
31	Percidæ (Sea Perches)	Bass or Bar <i>Labrax lupus</i>	Loubine, Drénec, Brigue, Loup	Late summer (floating spawn)	Coast (sand, mud), estuaries (young)	"
32		Bass or Sea Perch <i>Serranus cabrilla</i>	Serrane Cabrille, Sonneur, Violon	April- September	Coast (sand, mud)	Channel, Bay of Biscay, Mediter- ranean
33		Sea Perch <i>Serranus scriba</i>	Serran Écriture, Sarron, Partego	June- September	Coast (rocks, pebbles)	Mediterranean (rarely British waters)
34		Sea Perch <i>Serranus hepatus</i>	Serran Hépaté, Tambour	April- August	"	"
35	Sciaenidæ (Meagres)	Umbrina, Omber <i>U. cirrhosa</i>	Ombre, Bourrugue	Spring (eggs sub- merged)	Coast (sand, estuaries), some- times ocean banks	Atlantic, Bay of Biscay, Mediter- ranean
36		Meagre <i>Sciaena aquila</i>	Maigre	Summer	Coast (sand, estu- aries) in summer ; deep water in winter	Channel, Atlantic, Mediterranean

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
37	Sciaenidæ (Meagres)	Meagre <i>Sciaen nigra</i>	<i>Sciène-ombre, Maigre de l'Aunis</i>	Summer	Coast (sand, estuaries) in summer ; deep water in winter	Bay of Biscay
38	Scombridæ (Mackerel)	Common Mackerel <i>Scomber scomber</i>	<i>Maquereau, Roblot, Auriol</i>	Spring and summer (floating eggs)	Coast (spring, summer, autumn), deep water in winter	North Sea, Channel (Baie de Somme, Start Point, Irish coast), Atlantic, Mediterranean
39	"	Spanish Mackerel <i>S. colias</i>	<i>Auriol, Yol, Biar</i>	"	Deep water (100 to 500 fathoms) in winter ; the coast during the rest of the year	" "
40	"	White Tunny <i>Thynnus germon</i>	<i>Germon, Thon blanc</i>	Early spring (in seaweed)	Deep water (in winter), open sea 55° to 68° Fahr. in the Atlantic ; coast (summer) in the Mediterranean	Channel (as far as Roscoff), Bay of Biscay, Mediterranean

41	"	Tunny <i>Thynnus thynnus</i>	<i>Thon</i>	"	"	Bay of Biscay, Mediterranean
42	"	Dolphin, Bonito (<i>T. Pelamys</i>)	<i>Bonite, Pélamyde</i>	"	"	Mediterranean
	Scombresocidæ	(Garfish, Gar-pike) <i>Belone belone</i>				
43	Carangidæ (Horse Mackerel)	Horse Mackerel <i>Caranx trachurus</i>	<i>Saurel, Carangue, Chichard, Maquereau</i>	May-June (floating eggs)	Deep water	Channel, Atlantic, Mediterranean
44	Cyttidæ	John Dory, Jew- fish, St. Peter's Fish <i>Zeus faber</i>	<i>Zêe-forgeron, Poisson Saint Pierre, Dorée</i>	Spring and summer (floating eggs)	Coast (sand)	"
45	Sparidæ (Sea Bream)	Gilt-head <i>Chrysophrys aurata</i>	<i>Daurade, Scauquena</i>	"	Coast (sand, mud, fishponds, creeks)	"
46	"	Bream <i>Box vulgaris</i>	<i>Bogue</i>	Twice a year (?)	Coast (rocks)	"

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
47	Sparidae (Sea Bream)	Bream <i>Pagrus vulgaris</i>	<i>Pagré, Bagre</i>	Summer	Coast (rocks) in summer, deep water (mud) in winter	Mediterranean
48	"	Bream <i>Box salpa</i>	<i>Saupe</i>	"	"	"
49	"	Golden Bream <i>Pagellus auriga</i>	<i>Denté, Daurado</i>	"	Open sea	"
50	"	Black Sea-bream, Old Wife <i>Pagellus centrodontus</i>	<i>Pagel, Bezugo</i>	End of spring (floating eggs)	Coast (rocks, wrecks) in summer, deep water in winter	Channel, Bay of Biscay, Atlantic, Mediterranean
51	"	<i>Oblada melanura</i>	<i>Oblade, Oblado</i>	Summer	"	Mediterranean
52	"	<i>Pagellus vulgaris</i>	<i>Pagel, Pagneau</i>	"	"	Bay of Biscay, Mediterranean
	"	Spanish Bream <i>Pagellus owenii</i>		"	"	Channel, Atlantic

53	"	Becker <i>Pagellus erythrinus</i>	Pagel	"	"	"	Bay of Biscay, Mediterranean
54	"	Sar <i>Sargus vulgaris</i>	Sargue	End of spring (floating eggs)	"	"	"
55	"	Common Bream <i>Cantharus lineatus</i> <i>C. griseus</i>	Canthère, Brême	July, August	"	"	Channel, Atlantic, Mediterranean
56	Labridæ (Wrasses)	Wrass <i>Labrus bergylla</i>	Labre-vieille	April (lays eggs in nest among algæ)	Coast (rocks, weeds)	"	Channel, Atlantic (rarer north)
57	"	Green Wrass <i>L. viridis</i>	Rouchié, Labrévert	"	"	"	Mediterranean
58	"	Peacock Wrass <i>Crenilabrus pavo</i> [British species: Ballan Wrass, <i>C. maculatus</i> , Striped Wrass, <i>C. mixtus</i> , and Goldsinny, Cork-wing, <i>C. melops</i>]	Ploumarenec de nid	"	"	"	Channel, Atlantic (rarer north)

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
59	Labridæ (Wrasses)	<i>Crenilabrus massa</i>	<i>Ploumârenc de nid</i>	April (lays eggs in nest among algæ)	Coast (rocks, weeds)	Channel, Atlantic (rarer north)
60	"	<i>Fulvis vulgaris</i>	<i>Girelle</i>	April and May	" "	Mediterranean
61	"	<i>Fulvis pavo</i>	<i>Girelle paou</i>	" "	" "	"
62		<i>Chromis castanea</i>	<i>Castagneau</i>	April, May	" "	"
63	Mænidæ	<i>Mæna vulgaris</i>	<i>Mendole</i>	July-August	" "	"
64	Salmonidæ	Salmon <i>Salmo salar</i> (Many other species)	<i>Saumon</i>	" "	Ascends rivers to spawn	Atlantic (Scotch and Irish lochs and rivers), North Sea (east coast rivers), Channel (Seine, rivers of Devon and Cornwall), Saint-Nazaire (Loire), Irish Sea (Welsh rivers), &c.

65	"	Sea Trout, Salmon Trout, Salmon-peel <i>Salmo trutta</i>	<i>Truite saumonée</i>	November- January	"	"	"
66	"	Smelt <i>Osmerus eperlanus</i>		March- May	Estuaries, ascends rivers to spawn	North Sea (Broads), Channel (Seine)	
	"	(Caplin) <i>Mallotus villosus</i> (A species of cod is also sold as caplin)		April-May	Deep water (sand), spawns in bays	Newfoundland, Iceland	
67	Ammodyte (Sand-eels)	Lesser Sand-eel <i>Ammodytes tobianus</i>	<i>Equille</i>	April-June	Sand of the sea- shore, buried in the sand at low water	Channel, Atlantic, &c.	
68	"	Greater Sand-eel <i>A. lanceolatus</i>	<i>Lançon Hamille</i>	" "	" "	" "	
69	"	<i>A. sculus</i> or <i>A. cicerellus</i>	<i>Cicerelle</i>	" "	" "	Mediterranean ; former sometimes in Channel	
70	Atherinidæ	False Smelt <i>A. presbyter</i>	<i>Athérine prêtre, Abusseau, Faux- éperlan, Roséti</i>	February- April, July- September	Coast (estuaries, harbours)	Channel, Atlantic	

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
71	Atherinidæ	False Smelt Riquet's Atherine <i>A. Riqueti</i>	<i>Athérine, Abusseau, Faux-éperlan, Rosérot, Nonnat</i>	February-April, July-September	Estuaries (adaptable to fresh water)	Mediterranean (estuaries and canals of the Midi)
	"	(also <i>A. Boyeri</i>)	(fry known as <i>nonnals</i>)			Mediterranean
72	"	<i>A. hepsetus</i>	<i>Sauclet, Melet</i> (sold as anchovies)		Coast (estuaries, harbours)	"
73	Mugilidæ (Grey Mullet)	Grey Mullet <i>Mugil cephalus</i>	<i>Mulet céphale, Cabot</i>	July-September	Coast (estuaries, rocks, marshes, fishponds; ascends rivers); open sea	Channel (Somme), Bay of Biscay (Arcachon), Mediterranean (fishponds)
74	"	Grey Mullet <i>Mugil capito</i> , also <i>ocloradiatus</i>	<i>Capiton</i>	May-June	" "	" "
75	"	Grey Mullet <i>Mugil auratus</i>	<i>Mulet doré, Gaoula roussa</i>	" "	" "	" "
	"	(Grey Mullet) <i>Mugil septentrionalis</i>		" "	" "	Channel

76	"	Thick-lipped Mullet <i>Mugil labeo</i>	<i>Mulet labéon</i>	" "	" "	Mediterranean
77	"	Grey Mullet <i>Mugil chelo</i>	<i>Mulet à grosses lèvres, Chaluc</i>	" "	" "	Bay of Biscay, Mediterranean
78	Gadidæ (Cod)	Cod <i>Gadus morrhua</i>		February (in European waters), in the colder seas, nine consecutive months of spawning	Ocean banks, slopes of shoals (gravels and sands) in waters at 43° to 45°; after spawning in deep water	Channel, North Sea (Dogger), coast of Norway, Shetlands, Orkneys, Hebrides, Newfoundland, Iceland
79	"	Haddock <i>Gadus æglefinus</i>	<i>Egrefin, Morue noire</i>	End of winter	Coast (sand), ocean banks, 15 to 220 fathoms	All the North Sea, Channel, Atlantic
80	"	Pout, Bib, Whiting-pout <i>Gadus luscus</i>	<i>Tacaud</i>	"	Deep water (rocks)	" "
81	"	Caplin <i>G. minutus</i>	<i>Capelan</i>	April, May	Deep water (sand), spawns in bays	North Sea, Chan- nel, Newfound- land, Iceland, Mediterranean

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
82	Gadidæ (Cod)	Whiting <i>Merlangus vulgaris</i> (<i>G. merlangus</i> , Günth.)	<i>Merlan</i>	April-June	Coast (sand, ocean rocks), banks (10 to 110 fathoms)	All the North Sea, Channel, Atlantic
83	"	Pollack <i>M. pollachius</i> (<i>G. pollachius</i> , Günth.)	<i>Merlan jaune</i> , <i>Eglefin</i>	" "	" "	North Sea, Channel, Atlantic
84	"	Coalfish, White- fish <i>M. carbonarius</i> (<i>Gadus virens</i> , Günth.)	<i>Merlan noir ou</i> <i>vert</i> , <i>Charbonnier</i>	" "	" " (frequents deeper water)	" "
85	"	Ling <i>Molva vulgaris</i>	<i>Lien</i> <i>Morue longue</i>	" "	" "	" "
86	"	Pout, Blue Pout <i>Merlangus</i> <i>poutassou</i>	<i>Poutassou</i> , <i>Merlan bleu</i>	" "	Coast, ocean banks	North Sea (Norway), Medi- terranean
87	"	Hake <i>Merluccius vulgaris</i>	<i>Merlus</i> , <i>Merluche</i> , <i>Saumon blanc</i> , <i>Colin</i>	Spring (?)	Coast (sand), ocean banks (260	Atlantic, especially entrance of Chan-

88	" "	Burbot or Rock-living, Rock Cod <i>Motella mustela</i> , <i>Tricirrhata</i> , <i>Macrophthalma</i> , and <i>Maculata</i>	<i>Mustèle, Furet</i> The young are known as Mac-kerel Midge	"	Deep water, rocks and sand; the young are met with on the surface in the open sea	fathoms), the surface at night in pursuit of pilchards, &c.	nel, Bay of Biscay, Mediterranean
89	Pleuronectidæ (Flatfish)	Smeardab <i>Platessa microcephalus</i>	<i>Limande-sole</i>	April-July	Deep banks		North Sea (Great Fisher Bank, Shetlands), Atlantic
90	"	Craig-Fluke <i>Pl. cygnoglossus</i>	<i>Fausse-limande</i>	" "	Banks and coast		North Sea, Channel
91	"	Dab <i>Limanda vulgaris</i>	<i>Limande, Lime</i>	May-June	Coast (sand), shallow banks at sea		North Sea (southern half), Channel, Atlantic (not far south)
92	"	Plaice <i>Platessa vulgaris</i>	<i>Plie, Tardineau, Plana</i>	" "	Coast (sand), ascends rivers		Same, and Mediterranean

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
93	Pleuronectidæ (Flatfish)	Flounder <i>Flesus vulgaris</i>	<i>Flondre, Moineau de mer, Picaud</i>	Summer	Coast (sandy shores), estuaries, ascends rivers	North Sea, Channel, Atlantic
94	"	Halibut <i>Hippoglossus vulgaris</i>	<i>Flétan</i>	"	Coast (sand) and deep banks at sea	North Sea (Great Fisher Bank, and north of Flam- boro' Head)
95	"	Common Sole <i>Solea vulgaris</i>	<i>Sole franche, Perdrix de mer</i>	February- March (eggs float about 60- 80 ft. from bottom)	Coast (fine sand near rocks) be- tween 5 and 40 fathoms (sum- mer), banks be- tween 40 and 60 fathoms (in winter)	North Sea, Channel, Atlantic, Mediterranean
96	"	Lemon Sole, <i>Solea aurantica</i> , <i>Solea lascaris</i>	<i>Sole lascaris, Sole pole, Berruga</i>	"	"	"
97	"	Klein's Sole <i>Solea Kleini</i>	<i>Rhombou</i>	"	"	Bay of Biscay

98	"	Dwarf Sole <i>Solea minuta</i> and <i>S. melanochira</i>	<i>Sole brusque</i>	March- June	Coast (sand, shallows, and up to 25 fathoms)	Atlantic
99	"	<i>Solea cuneata</i>	<i>Sole-Sîteau</i>	"	" "	Mediterranean
100	"	Eyed Sole <i>Solea oculata</i>	<i>Sole ocellée</i>	"	Ocean banks (150 to 250 fathoms)	Atlantic
	"	(Bloch's Topknot) <i>Phrynorhombus unimaculatus</i>		"	Coast (rocks and weeds)	Mediterranean
101	"	Mary Sole, Merry Sole, Sail Fluke, Whiff, Megrim <i>Ph. megastoma</i> (<i>Rhombus megastoma</i> , <i>Günth.</i>)	<i>Mère-sole</i>	"	Banks, open sea, 150 to 250 fathoms	Atlantic
102	"	Turbot <i>Rh. maximus</i>	<i>Turbot, Rhombe, Cailleteau</i>	June-July	Coast (sand) in summer, deep water in winter	North Sea (Dogger, north-west of Thornton Banks), Channel (Varne), Atlantic, Mediterranean
103	"	Brill <i>Rh. larvis</i>	<i>Barbue, Barbuche, Rombou</i>	February-June	Coast (sand)	Channel, Atlantic

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
104	Clupeidæ	Herring <i>Clupea harengus</i>	<i>Hareng</i>	Off the coast of France, October–December (submerged eggs)	Surface of the sea and bays; deep water (summer)	North Sea—summer fisheries off the coast of Scotland and the Shetlands; Yarmouth season, September, off East Anglian coast; autumn season off Flemish coast; autumn and winter season off the coast of Picardy, Normandy, towards Granville Bay; Atlantic; coast of Cornwall and Brittany (occasional)
105	"	Sprat <i>Meletia sprattus</i>	<i>Sprot, Esprot, Æillet, Harenguet</i>	Autumn	Deep water (summer), coast (bays and estuaries) in	North Sea, Channel, mouths of Thames and

"	Pilchard or Sardine <i>C. pilchardus</i> , or <i>Alosa sardina</i>	<i>Sardine, Alose- sardine, Celan</i>	Summer- Autumn (?) Novem- ber (?) (floating eggs)	Coast (shallow waters, or sur- face), open sea (surface or shal- lows), deep water (sand, mud), temperature about 53°6°	autumn and winter	Seine, coasts of Brittany and Cornwall
"	Summer Sardine (Baited net fishing)	<i>Sardines de rogue</i>	April-May	Coast (surface) and open sea		Channel, Atlantic, coast of Corn- wall; coasts of Picardy, Nor- mandy, Brittany; north of Bay of Biscay (May to November), south of Bay of Biscay (November to May), Mediter- ranean
"	(Drift net fishing)	<i>Sardine courause</i>	" "	" "	" "	Atlantic (June- September), Mediterranean (September-May)
"	Winter Sardine	<i>Sardine d'hiver</i>	" "	" "	" "	Atlantic (January- May), Mediter- ranean (Septem- ber-July)
						Atlantic

No.	Family.	Species.		Spawning Time.	Habitat.	Distribution.
		Usual Name and Classification.	French Name.			
107	Clupeidæ	Whitebait (A mixture of young sprats, herring, and pilchards)	<i>Blanquette, Menise</i>	April-May	Coast (estuaries, "sea-meadows," i.e., over weedy bottoms)	North Sea, Channel, Atlantic
108	"	Anchovy <i>Engraulis encrasicolus</i>	<i>Goulard, Goulu</i>	" "	Coast and surface of open sea,	" "
	"	"		May, September	Coast and open sea, deep water in April	Mediterranean (May-September)
109	"	Shad, Alice Shad <i>Clupea alosa</i>	<i>Alose</i>	March-June (in rivers)	Coasts, rivers, and open sea	North Sea, Channel, Atlantic, Mediterranean
110	"	Thwaite Shad <i>C. finta</i>	<i>Finte, Alose-finte</i>	May-July	Coasts, rivers, and open sea	North Sea, Channel, Atlantic, Mediterranean
111	Exocoetidæ	Flying Fish <i>Exocoëtus</i> and <i>Belone vulgaris</i>	<i>Orphie, Becasse de mer</i>	" "	Coasts, rivers (summer)	Atlantic, Mediterranean

112	Aulostoma	Pipe Fish <i>Centriscus scolopax</i>	<i>Becasse de mer</i>	" "	Open sea	Mediterranean
113	Anguillidæ (Eels)	Conger <i>Conger conger</i>	<i>Anguille de mer</i>	March-May	Coast (estuaries, rocks, weed-beds)	North Sea, Channel, Atlantic
114	"	<i>Myron conger</i>	<i>Petit congre</i>	" "	" "	Mediterranean
115	"	<i>Muraena</i> <i>Muraena helena</i>	<i>Murène commune</i>	" "	Deep water (crevices of rocks)	"
116	"	<i>Muraena unicolor</i>	" "	" "	" "	"
117	"	<i>Muraena</i>	<i>M. sorcière</i>	" "	" "	"
118	"	Common Eel <i>Anguilla</i>		" "	Descends to sea to spawn ; coastal ponds, broads, dikes, lagoons, rivers ; close to shore	North Sea (Holland), Channel, Atlantic, Mediterranean
119	"	<i>Poutina</i> A mixture of young Atherines, Sardines, and small Gobies (<i>Aphyes pellucides</i>)	<i>Poutina, Nouna</i>		Coast, in-shore	Mediterranean (Nice)

CHAPTER II

FISHING-GROUNDS

- I. The continental plateau of the Atlantic ; the in-shore and off-shore districts ; the Channel. II. The threshold of the Mediterranean. III. The North Sea and the Dogger Bank. IV. The banks of Newfoundland. V. The banks of Iceland. VI. The Atlanto-Saharan or Morocco banks and the Baie du Lévrier (Bahia del Galgo).

FISH are not sufficiently defined by their biological and geographical characteristics ; we must also consider their natural habitat and surroundings.

I

The fishing-ground *par excellence* is the continental plateau of the Atlantic. This name is given to the intermediary ledge or series of flats between the coast and the great oceanic depths. It is the foundation upon which western Europe is built ; it is the bond of union between England and the Continent. Its area increases as we go northward. On the west coast of Spain it is only a few miles wide ; France it surrounds with a wide girdle, while it encircles and supports Ireland, England, Scotland, the Orkneys, and the Shetlands, and forms the entire floor of the Irish Sea, the Channel, and the North Sea. It runs along the coast of Norway, and finally expands to the north of Siberia. Its greatest depth is not more than 100 fathoms. It is

lit by the light of the sun, so that it is covered by abundant growths of marine plants. The sediments which cover it are of mud, sand, gravel, and pebbles; the dust carried by the winds is deposited upon it, and it receives the alluvial burden of the rivers. The action of the waves, which affects it to an average depth of 25 fathoms, divides it into two regions: the coastal or in-shore region, which is often disturbed by the overlying waters, and the off-shore region, where a greater calm prevails. The former is subject to almost daily changes of temperature, and the bottom is irregular and varied. In the latter region the floor is generally level and the temperature more constant.

The in-shore region comprises the space between the extreme tide-marks and such parts as are always submerged by not more than 25 fathoms; it embraces rocks, reefs, and islands. The rocks, as a rule, become smaller as the depth becomes greater, while the algæ which clothe them become longer. The sandy beaches are succeeded by the "meadows" of sea-grasses—monocotyledons of the *Zostera* family—which in turn are succeeded by the Bryozoarian deposits and conchiferous debris. The in-shore region comprises by definition all the articulations of the coast: capes, bays, estuaries, lagoons, and salt-water ponds. Mud is predominant, more or less mingled with sand, and the sea-meadows of the Armorican peninsula are choked with it. The bay of the Seine, which is from 9 to 25 fathoms in depth, is a marvellous trawling-ground. Of the salt-water ponds and lagoons I will here mention only that of Arcachon. According to my friend M. Camille Mader, who knows it better than any one, this little inland sea of 37,000 acres (58 square miles) is simply the ancient estuary of the Leyre. The mud is slowly

and constantly encroaching upon it, and except in the western portion, where there are a few submerged rocks, the depth is inconsiderable.

The rocks are beyond all computation. Sometimes, as in Brittany, they are isolated; sometimes they take the form of a series of steps, as on the west coast of Groix; sometimes they form long reefs, as at Calvados. The floor of the sea is often crossed by valleys, as to the north of the Gironde (other instances are the Cardinals and the Pilier between Yeu and Belle-Ile), or pitted with depressions (such as the Devil's Sea facing Etretat, the Rays' Hole to the north-west of the Ile de Batz, the Pirlon Hole to the north-north-west of the Ile d'Yeu, &c.).

The off-shore region is characterised by its level rocky plateaux, strewn with pebbles, rocks, gravels, and heaps of shells; its irregular sandy plains, often interposed between the rocky portions; and lastly, by its rocky chasms. Here and there we find white and green ooze. The simplest form of rocky plateau is exemplified by the Marzelles, WNW. a quarter W. of the Chassiron light on Oléron. It consists of enormous flat rocks lying on the bottom. There are many rocky shoals belonging to this category, such as the Chapelle, 120 miles west of Penmarch, which rises in a steep slope from a depth of 155 fathoms to a depth of 40 fathoms, and the shoal of Rochebonne, of which I shall speak presently. Sandbanks, or shoals of fine sand, are very widely distributed. The Sole banks, which are just at the entrance of the Channel, and on the meridian of Cape Clear in Ireland, measure some 1,800 square miles in area. The Little Sole banks, to the south of the former, have an area of about 530 square miles. Both slope towards the west,

the soundings being from 70 to 100 fathoms. The Rochebonne banks, 40 miles west of the Ile de Ré, have an area of 950 square miles. Soundings are from 24 to 48 fathoms, excepting in the centre, where there is a shoal covered by only a few feet of water—from 9 to 24—at low tide. The Jones banks and the Nymph banks are situated at the entrance to the Irish Sea. The Start banks surround the Eddystone light, off Plymouth Bay, and are less than 35 fathoms below the surface. The most celebrated of the ditches is the Hague ditch, to the NW. of the Cape of that name. Its length is 11 miles, its width three-quarters of a mile, and its depth from 32 to 50 fathoms. The sides are not particularly steep, but are rocky, and are covered with pebbles, some of which are as much as 2 lbs. in weight.

The 100-fathom line, or “mud line,” coincides almost everywhere with the edge of the continental plateau. At this line begins the descent into the depths of the ocean—depths of 9,000 and 10,000 feet. The slope is gradual, but in the neighbourhood of Cape Breton there is a breach in the wall. Here and there a few upstanding rocks break the uniformity of the oceanic mud. From 100 to 650 fathoms this mud is grey or bluish. Lower still are deeper layers of water, depths and abysses which we shall not have to deal with here. In these depths there is continual darkness, the temperature is not far from freezing-point, and eternal peace is supreme.

II

From the Gulf of Rosas to Cape Cerberus the coast, built of ancient rocks, is cut up by indentations like the Breton *rias* and the Norwegian fjords. At the edge of

the Bay of Banyuls the shore grows flatter ; there are the sands and low beaches of Roussillon and Languedoc, concealing lagoons and salt-water lakes. Then comes Cap Couronne. The coast turns inward to the range of the Maures and the Estérul and the outer ramparts of the Alps. The submarine topography of the Mediterranean may be indicated in a few words. Wherever the coast is high and rocky the continental shelf is narrow ; wherever the coast is low and sandy the shelf is wide. Thus the 100-fathom line runs from the Cap de Creus and the bay of Marseilles almost in a straight line, while in Provence it hardly leaves the coast.

Owing to the absence of appreciable tides the in-shore regions are always submerged. Below the sands are stretches of mud ; beyond the rocks is the "pavement," the sea-grasses or meadows, and the coralligenous deeps. The "pavement" is an anfractuous belt, formed of calcareous algæ ; and the coralligenous deeps, the *broundo* of the fishermen, consist of masses of shells and small gravels. The Mediterranean pools and lagoons are of two types : there are the closed bays, the great *calanques* (coves), in direct and constant communication with the sea, and the lagoons, divided from the sea by a barrier and connected with it by narrow channels. The pool of Berre, like the pool of Morbihan in the Atlantic, belongs to the former type ; the pool of Thau to the second. The former, covering an area of some 37,000 acres, is from $1\frac{1}{2}$ to 6 fathoms in depth ; in the course of a century the alluvial deposits of the tributary streams have raised the floor by nearly 3 feet. The latter is of about one-half the area of the former, and its depth is about a fathom less in the deepest parts. The floor is of sand and mud, and the water is brackish.

The in-shore region offers three principal aspects.

From the Cap de Creus to Marseilles the belt between the 25-fathom and the 50-fathom lines consists of a sheet of colloidal, yellowish-grey ooze, and from Marseilles to Nice of muddy sands and gravels, which I had occasion to study on board the yacht *Andrée*. Between the 50-fathom and the 100-fathom lines we find everywhere a thick bed of sand and coarse gravel, whence emerge the crests of a series of rocks disposed along a line from the Pyrenees to the Alps.

To the east of Banyuls the edge of the Mediterranean shelf is cut up by ravines known as *rechs*, which are from 300 to 350 fathoms in depth. To the south of the island of Riou the slope is almost vertical, and is known as the Peyssonnel Cliff. It falls 350 fathoms, but its upper portion is interrupted by a projecting platform, known as the Marsilli plateau. To the east of the Peyssonnel Cliff the edge of the shelf forms a projecting spur known as the Blanquières bank.

At the foot of the slope, at a depth varying from 350 to 500 fathoms, where the temperature is constant and uniform at 54.8° , the deep bottoms are covered with deep-sea corals, stiff but plastic muds, and, in the deepest depths of all, with a fine, soft, greenish-yellow ooze.

III

There are fishing-grounds which, although at a great distance from France, are worked by French vessels. Everyone knows them. They are the Newfoundland and the Iceland banks, the banks of the North Sea, including the Dogger, the African ledge off Morocco, and the Baie du Lévrier.

The North Sea is only a portion of the continental plateau of the Atlantic. If the sea were suddenly to sink some 40 fathoms, one might travel afoot, on horseback,

or by automobile, all over a region lying between Newcastle and the north of Jutland ; rich, fertile plains would stretch from Hull to Denmark, from Yarmouth to Hamburg, from London to Rotterdam, and there would no longer be any question of a Channel tunnel.

The Elbe, the Weser, the Ems, the Rhine, the Meuse and the Escaut and the Thames would water this enormous plain, which would be dominated by a single plateau, 200 feet in height, 300 miles long, and 36 miles wide—the Dogger. This is not an idle vision ; it is a picture of what once existed. The sides of the Dogger hills formerly sheltered mammoths and rhinoceros, and in this very place primitive man may once have hunted his prey with his weapons of worked flint.

Let us imagine a section of the floor of the sea from the Orkneys to Heligoland. The ground gradually sinks to a depth of 80 fathoms, then rises to 50 fathoms, and presently to 40. The Dogger Bank, which adjoins it, is only 15 fathoms below the surface ; its south-eastern slope sinks to 23 fathoms, and is joined by a submarine beach to the island of Heligoland, in some 20 fathoms of water. Now take a second section, perpendicular to the first, lying between Hull and the centre of the Skagerack. The bottom descends in a gentle slope to a depth of 35 fathoms, climbs the south-western flank of the Dogger, which brings it to within 40 feet of the surface of the sea, and continues in the form of a tableland 20 fathoms deep before joining the Skagerack. I should mention that this strait, which is at least 250 fathoms deep, is the southern portion of the great Scandinavian depression, called the “Norwegian dike,” by the naturalist-hydrographers of the “Permanent International Council for the Exploration of the Sea.” The Norwegian dike runs all along the Norwegian coast. A third line, parallel to the second,

but a little further north, will cross the Great Fisher Bank, which lies in some 38 fathoms of water, and touches the edge of the depression.

To remember these three sections is to remember the topography of the 134,000 square miles of the North Sea. Let us take the Dogger as a centre. To the south, below an imaginary line drawn from Flamboro' Head and the north of Denmark, all soundings, except those of the Silver Pit, are less than 25 fathoms. There are numerous banks; on the English side the Sole-pit, the Dowsingwell, Goodwin Sands, the Brown Ridge, &c.; on the Dutch and Belgian side the Sandetti, the Ruytingen, and the Thornton; on the Prussian side the Schwartz-Bank, the Borkun-Riff, and the Heligoland-Rucht. To the north of the Dogger, or above the same imaginary line, the depth varies from 25 to 80 and 100 fathoms, without counting the Norwegian dike. Towards the east is the Little Fisher Bank; towards the north-east is the Great Fisher Bank; towards the north-west is the Long Forties, the Outer Pit of Montrose, &c.

The Dogger and its northern region belong to the in-shore district. There is sand almost everywhere. Gravels and broken shells mark on the sea-floor the direction of powerful currents. Mud and slime lie in fan-shaped stretches around the estuaries, as well as in the fjords and firths. They are found mixed plentifully with sand in the Danish lagoons; in Staveningfjord and Lüm fjord. The off-shore region is rich in mud, especially the Norwegian dike. I need not repeat the general description of the continental plateau; I refer the reader to that already given.

IV

The Banks of Newfoundland are a fluvial formation resting on the American continental plateau. This

plateau is 100 fathoms below the surface, and overhangs the Atlantic depths of 1,000, 1,500, and 4,000 fathoms. In short, the Newfoundland Banks are a submarine delta, the delta of the Cabot current, which, draining the whole of the waters of the St. Lawrence, finally becomes dissipated by the Polar current and the Gulf Stream, as Professor Thoulet has demonstrated in a masterly manner. The materials in suspension are deposited where the currents meet, and form submerged islands. They consist of the debris of the blue rocks of the west coast of Newfoundland and the red rocks of Labrador, and, in a less degree, of the white sands which come from the east coast of the island. Not only the Cabot current, but the shore ice, of marine origin, brings all kinds of debris. From February to April the floe ice drifts in all directions, always moving, thanks to the three currents, and melting as it floats into warmer waters. The effect of fresh-water icebergs or packs is practically negligible in respect of sedimentary deposits. The sharp edges of the pebbles found by the Prince of Monaco, and the lumps of coal dropped overboard from passing steamers, which have remained unbroken in spite of their fragility, prove that the bottom is not abraded by the bases of floating icebergs. The icebergs come from May to September; as a rule, they are thickest off the southern edge of the Banks.

The Newfoundland Banks are divided into two groups—one to the left and one to the right of the axis of the Cabot current produced seaward. Sailing from the coast towards the open sea, we find on the left-hand side St. Peter's Bank, facing the French islands of Saint-Pierre and Miquelon, the Green Bank, and the Great Bank; while to the right are the Canso Bank, the Misaine, the Artimon, and the Banquereau.

St. Peter's Bank is triangular; its slope is most abrupt towards the north-west. It contains no holes, which are signs of rapid currents. The plateau rises gradually in a succession of almost parallel contours; the depth is 50 fathoms on the edge, then 40, then 35, 30, and finally, towards the middle, 25 fathoms. The closing up of the fathom-lines—between the 50 and 30 fathom lines at the north-eastern extremity, the 50 and 35 fathom lines at the south, and the 50 and 40 fathom lines on the eastern side of the triangle—shows that the Cabot current retains its maximum force longer in the depths, and that its rapidity decreases as it nears the surface or flows further south. The structure of the bank is simple: broken shells, sands, a little ooze, and pebbles. The shell-banks are disposed along a line following the eastern slope; the sands occupy the northern extremity and the southern corner of the bank; the ooze lodges in the slight depressions, and the pebbles are arranged in parallel belts; they are plentiful to the north, but rare to the south.

The Green Bank is roughly egg-shaped. It lies north and south. The line of greatest width is deflected upwards, as the left branch of the Cabot current is itself deflected, and turns towards the south under the action of the Polar current. The more abrupt slopes are to the north-west and the west. The depth varies from 50 fathoms on the edges to 35 in the centre. The sands are found up-stream—that is, towards the west; the shells in the more sheltered depths, down-stream; the pebbles are collected along the foot of the bank, and form a continuation of those of St. Peter's Bank.

The Great Bank opens out like a fan from west to east. It is as large as Ireland. Its northern and eastern

flanks are sloped by the Polar current, its southern flank by the Gulf Stream ; while Cabot's current washes its western corner. The surface of the Great Bank is hilly. Its depth along the edges is 50 fathoms ; over the greater part of its eastern regions, known as the Flemish Bonnet, soundings are 35, 30, and 25 fathoms. The western extremity is irregular, as though much disturbed ; there are shoals of 25 fathoms beside depressions of more than 50 fathoms. The largest of these holes, known as Whale Hole, is 60 fathoms in depth ; close by it is a narrow depression 10 fathoms deeper. These holes are due to eddies and back-washes, caused by the encounter, at right angles, of the Polar current and Cabot's current. To the east the Great Bank is covered with white sands, very fine and glistening ; to the west with grey sands, plain or speckled, which are strewn with broken shells and pebbles.

The Canso, Misaine, and Artimon banks are also irregular. The edges are some 50 fathoms below the surface ; the centre, 40 fathoms. The Misaine, which is the largest of the three, has seven holes, more than 50 fathoms in depth ; these are the work of the eddies caused by the meeting at right angles of the left side of the Gulf Stream with the right side of Cabot's current. They consist very largely of sand, but there are many pebbles, brought by the shore ice and dropped as the icebergs thaw in the summer.

The Banquereau yields the following data. Edges, 50 fathoms ; western portion, 30 to 20 ; central portion, 35 ; eastern portion, 30 to 25. There are no eddies, and therefore no holes. It is swept by the central currents of the Gulf Stream and Cabot's current, which cover it with black and grey sand. These deposits are so abundant that the bank tends to grow higher, and forms along its

circumference long spits of sand, like submarine Baltic *nehrungen*. Pebbles are rare.

There remains a series of secondary banks on either side of the Cabot current. On the left-hand side these banks stretch southwards as far as the Avalon peninsula, between the Saint-Pierre and Miquelon Islands and the Bay of Fortune in Newfoundland; to the right they run between Cape North and Cape Breton in Nova Scotia. These are lateral outliers of the delta of the Cabot current, which brings the sand, while the shore ice carries the debris of all kinds of rocks. To sum up—and this applies to the Newfoundland banks as a whole—there have been, and are, two periods in the formation of these banks: the period of transportation or deposition, and the period of shaping or modelling. The Cabot current and the broken packs of shore ice act like so many huge ballast-trains; the Polar current and the Gulf Stream like gigantic excavators.

V

The banks of Iceland have quite a different history; their genesis and their morphology are entirely dissimilar. The better to explain them, I must first give certain essential data relating to the Atlantic Ocean.

Iceland is the visible summit of a submarine mountain. This mountain is of the greatest importance, as it is from its base that the three ridges run which to some extent form the skeleton or the framework of the Atlantic. The first has its origin on the northern slope, and runs towards the Arctic Ocean and Greenland. The second is the prolongation of the south-western spur of the island. It commences at Reykjanes Point, forms the foundation of the Fuglasker Islands, and on leaving the neighbourhood of Iceland plunges into the depths, runs in a south-

south-westerly direction, approaches the surface, and blossoms into an archipelago, which is none other than the Azores. It once more plunges into the depths, still continuing in a south-westerly direction, until it arrives within two or three hundred miles of the Brazilian coast. It then changes its course, running in a south-easterly direction as far as Ascencion, of which it forms the framework. Finally it runs as far south as Tristan d'Acunha. I will call this ridge the "Central Atlantic ridge." The third is the "Wyville Thomson ridge." It starts from the bluffs of the south-eastern portion of Iceland. In a straight unbroken line it stretches to the Farøe Islands, where, changing its direction, it turns to the south and terminates in the north-western point of Scotland. The Icelandic mountain is thus the starting-point of three great ranges of submarine mountains.

The Central Atlantic range is covered with volcanic debris. The Wyville Thomson range is perhaps of the same nature. Murray, however, believes it to be the remains of an ancient moraine, on account of the great number of glacial imprints which he has found on the rocks of the formation. It plays a part of the first importance in the distribution of temperature. Thus, at the same depth of 800 fathoms, the waters on the north-eastern side of the range have a temperature of 30.2° Fahr., while on the south-western side the temperature is never less than 39.2°.

In the space enclosed by the roots of the three ranges the Icelandic mountain rises in an abrupt slope from a depth of 1,000 fathoms. The first step coincides with the 500-fathom line. The second step, which is less abrupt, is 1,800 feet in height, or 300 fathoms. The third step is 600 feet high, or 100 fathoms, which gives a depth of 100 fathoms. As it completely surrounds the island with

a belt whose width varies from 18 to 60 miles, it is to Iceland what the continental plateau is to Europe ; it is the region of the Iceland fisheries—the Iceland bank.

The banks of Iceland reproduce on a large scale all the curves of the coast. They support three islands : in the north Grimsey, in the south-west Fuglasker, and in the south the Westmann Islands. Here and there high bottoms of 50 fathoms are found side by side with depths of 100 fathoms. The soil is thus relatively smooth. It is covered with sand, gravels, broken shells, pebbles, and a little ooze, sediment from the shore, and deposits of debris from the ice-pack, which melts in the summer, thanks to the ultimate northern reaches of the Gulf Stream. The fishing-grounds most frequented by French boats lie between Portland and Reykjavik, in the south and south-west, and are fished in summer ; more rarely, the ledge round Cape Horn in the north, the open sea off Dyraifjord on the west, and in the east the neighbourhood of Sejdísfjord and Fagrufjord.

VI

It is to M. A. Gruvel that we owe the most recent works on the fisheries of the West Coast of Africa. These fisheries must not be confounded with those on the Arguin bank ; there is no relation between the two. The Arguin bank is very little known, dangerous, and possibly anything but rich in fish. The Atlanto-Saharan banks, on the contrary (the term is used by my friend M. Pierre L. Bourdis) are an exemplary fishing-ground.

The African continental plateau runs uninterruptedly from Cape Sparte to the neighbourhood of the Cape of Good Hope. It is nowhere less than 60 miles wide. Beyond the 100-fathom line the floor slopes rapidly to 500 fathoms. On the chart, the 1,000-fathom line

closely skirts the 1,500-fathom line, after which the seabottom rises and sustains the Canaries and the Cape Verde Islands. To the west of the islands runs the 2,000-fathom line, marking the commencement of the great Atlantic abysses. From the south of Morocco to the neighbourhood of St. Louis in Senegal the region of the continental plateau known as the Atlanto-Saharan bank covers an area of 30,000,000 acres, or 48,000 square miles, and the Baie du Lévrier (Greyhound Bay), which forms an annex to the plateau, an area of some 250,000 acres, or nearly 400 square miles.

The depth of water does not exceed 100 fathoms on the plateau, or 12 fathoms in the bay. This bay, which is bounded by Cape Blanco on the west, and lies open to the Atlantic on the south, has the shape of an isosceles triangle. On the eastern side the $2\frac{1}{2}$ -fathom line is a long way from the shore—from 2 to 4 miles—but on the western side it almost touches the beach, being only 400 or 500 yards distant. From the north to the south we get the following soundings: $1\frac{1}{2}$, 2, $2\frac{1}{2}$, $3\frac{1}{2}$, 4, $5\frac{1}{2}$, 6, 7, 6, $7\frac{1}{2}$, 5, and $3\frac{1}{2}$ fathoms. To the right and the left of this central line the soundings are—to the east, from $3\frac{1}{2}$ to 6 fathoms; on the west, $3\frac{1}{2}$, 6, 7, $9\frac{1}{2}$, 10, 11, 7, $6\frac{1}{2}$, 8, 6, 5, and 7 fathoms. Finally, sailing from east to west at the mouth of the bay we obtain the following soundings: $3\frac{1}{2}$ (Cape Arguin), 2, $3\frac{1}{2}$, $6\frac{1}{2}$, 7, 8, 10, $6\frac{1}{2}$ (Greyhound Bank), 9, $12\frac{1}{2}$, and 10 (Cape Blanco).

To the north of Cape Blanco the Atlanto-Saharan plateau presents four natural zones. The first extends 4 miles out to sea from the shore; the depth is from 2 to $2\frac{1}{2}$ fathoms; it comprises hard shell sand, sand sprinkled with the crests of emerging rocks, and, in the latitude of Cape Blanco, a mixture of sand and ooze. The second zone, which is only 2 miles wide, and slightly sloping, as

it sinks from $22\frac{1}{2}$ to $27\frac{1}{2}$ fathoms, is characterised by flat schistous rocks. The third, some 7 or 8 miles wide, and from $22\frac{1}{2}$ to 30 fathoms below the surface, is an immense plain of shell sand, slightly mixed with ooze towards the south. The fourth zone, which extends to the extreme limit of the plateau, or the 100-fathom line, is an immense rocky plain.

Let us double Cape Blanco and enter Greyhound Bay. On the sill there is a shell-sand, more or less rich in greenish ooze, which is found in the midst of a yellowish shell sand, which is often covered with a thick bed of dark green ooze. A great part of this ooze is swept by the tidal current, which deposits it in a fan-shaped area at the mouth of the bay. To the south of the bay the Atlanto-Saharan bank continues to within a dozen miles of St. Louis. The floor of the sea consists of sandstones, scored by little valleys (*mariscots*) with gently sloping sides and filled with shell sand as well as with small quantities of ooze carried by the Senegal. The *mariscots* constitute excellent fishing-grounds.

CHAPTER III

THE OCEAN FEEDING-GROUNDS

- I. The salinity and density of marine waters, in particular on the fishing-grounds. II. Oceanic circulation—The physiology of the North Atlantic, the Gulf Stream, and the Wyville Thomson ridge—The physiology of the North Sea. III. The tidal currents of the Channel—Vertical currents. IV. The physiology of the African Atlantic. V. Plankton—Composition and physiology. VI. Its distribution and functions in relation to ocean currents. VII. The conditions of the formation of plankton. VIII. Plankton as an accumulator of energy—The problem of the alimentation of marine species—The cycle of oceanic life—The hygiene of the seas.

It is not enough to describe a city house by house, stone by stone, if we wish to enable others to know all about it ; we must explain its relations with the surrounding country, its means of communication with the neighbouring cities, and, finally, its means of subsistence. This task is imposed upon the historian as upon the oceanographer ; but for the second it is a little less difficult, as it reduces itself to the study of the open sea.

I

The salinity of water is expressed by the total weight (usually in grammes) of the solid matter dissolved in 1,000 grammes, &c., of water. The salts dissolved are chlorides, sulphates, bromides, and carbonates. Density is the mean weight in grammes of a cubic centimetre

of water at 0° C. ; that is, the specific weight as compared with the weight of fresh water at $+4^{\circ}$ C.¹ "The water of the ocean," says M. Thoulet, "is not everywhere of the same chemical composition. We must not regard sea-water as simply a solution, more or less concentrated, of the various salts whose presence is revealed by chemical analysis. This diversity of chemical composition is due to a host of causes, of which we will consider a few. The freezing of the sea-water in the polar regions causes a concentration of the sulphates in the ice thus formed, and of chlorides in the water. The waters of rivers reach the sea with small quantities of saline matter in solution. Reactions take place even in the interior of the upper layer of the ocean floor, where the living organisms gather certain salts to fix them in their tissues—some silicon, others calcium, others lead, zinc, bromine, or iodine salts ; in short, the reciprocal action of these salts, when one of them is added to or subtracted from the whole, gives rise to fresh combinations among the remaining salts." The waters of the continental plateau, the Channel, and the French Atlantic contain 34 to 35 grammes of salt per litre ; of the Mediterranean, 39 ; of the North Sea, 32 in the Skagerack, 34 and 34.8 in

¹ The temperature of distilled water at its maximum degree of density. In practice salinity is often expressed in terms of density.

Salinity.							Density.
13.1 grammes of salt per 1,000 grammes of sea-water							= 1.01
19.7	"	"	"	"	"	"	= 1.015
26.2	"	"	"	"	"	"	= 1.02
30	"	"	"	"	"	"	= 1.0226
32.8	"	"	"	"	"	"	= 1.025
35	"	"	"	"	"	"	= 1.0253
39.3	"	"	"	"	"	"	= 1.028
40	"	"	"	"	"	"	= 1.0289
45	"	"	"	"	"	"	= 1.0326
50	"	"	"	"	"	"	= 1.0365

the centre, and 35 in the northern portion (in all cases on the surface and at 20 fathoms). On the Newfoundland banks the salinity varies from 32·8 grammes (in the Gulf Stream) to 26·2 grammes (in Cabot's current). On the Iceland banks we find 32·25 grammes on the surface, 35·2 at 400 fathoms, and 35 grammes at 500 fathoms. On the Atlanto-Saharan bank, in the open sea, the proportion is 37·04; in Greyhound Bay it is 38 at high-water and 41 at low water.

The temperature is subject to much greater variations. In the Channel we obtain the following data¹:—

	February,	May.	August.	November.
Surface	41°03'—50°09'	46°72'—51°87'	59°—62°9'	53°65'—56°35'
Bottom	41°05'—50°41'	46°71'—50°66'	50°84'—59°04'	51°76'—56°53'

¹ Here is a series of temperatures from the Channel, taken from east to west:

February.

Surface, 41°03'—44°6'—46°08'—47°05'—48°2' (the Hague dike), 49°87'—50°27' (edge of plateau).

Bottom, 41°3'—44°6'—46°13'—49°89'—48°31' (the Hague dike), 48°2'—50°91' (edge of plateau).

May.

Surface, 44°72'—46°9'—48°29'—48°29'—49°24' (the Hague dike), 50°—51°02'—51°87' (edge of plateau).

Bottom, 44°71'—46°9'—48°3'—45°57'—48°29' (the Hague dike), 50°09'—49°49'—50°66' (edge of plateau).

August.

Surface, 59°11'—60°92'—60°91'—60°47'—59°29'—59° (the Hague dike), 59°—60°85'—62°27'—62°9' (edge of plateau).

Bottom, 59°04'—60°89'—60°85'—59°86'—59°11' (the Hague dike), 57°86'—55°76'—50°84'—51°74' (edge of plateau).

November.

Surface, 53°65'—53°69'—54°71'—55°16'—55°68'—56°35' (the Hague dike), 55°49'—55°63'—55°07'—55°09' (edge of plateau).

Bottom, 55°23'—54°62'—54°95'—55°34'—55°81'—56°51' (the Hague dike), 56°53'—55°76'—51°76'—53°76' (edge of plateau).

At Concarneau, according to M. Legendre, the temperature reaches its maximum, in summer, between the hours of 2.0 p.m. and 5.0 p.m., and its minimum shortly before sunrise. The tide has more influence upon the time of the maximum in the estuaries than along the coast. Along the coast of the Landes M. Hauteux has obtained the following data :—

			Winter.			Summer.
Surface	...	...	51°8°	...	...	71°6°
10 fathoms	...	...	51°8°	...	...	66°2°
15 fathoms	...	...	50°14°	...	...	60°89°
20 fathoms	...	...	50°02°	...	...	60°89°
30 fathoms	...	...	50°09°	...	...	55°49°

In the Mediterranean, during the month of July, I have taken the following temperatures: from the surface down to 50 fathoms I have obtained the following figures: 57°2° to 64°4° at 20 fathoms, 56°84° at 25 fathoms, and 55°4° at 50 fathoms. Below a depth of about 160 fathoms—the depth of the Straits of Gibraltar—the thermometer remains constant at 54°86°. From the enormous mass of statistics relating to the oceanography of the North Sea published by the “Permanent International Council for the Exploration of the Ocean” I have selected these figures :—

		February.	May.	August.	November.
Surface	...	37°4°–44°6°	44°6°–48°2°	53°6°–62°2°	44°6°–53°6°
10 fathoms	...	37°4°–44°6°	42°8°–48°2°	44°6°–62°2°	48°2°–53°6°
20 fathoms	...	39°2°–44°6°	41°–48°2°	44°6°–53°6°	48°2°–53°6°
30 fathoms	...	41°–44°6°	41°–46°4°	44°6°–50°	46°4°–50°
40 fathoms	...	41°–44°6°	41°–46°4°	42°8°–50°	46°4°–48°2°
50 fathoms	...	42°8°–44°6°	42°8°–46°4°	44°6°–48°2°	44°6°–48°2°

In the Newfoundland waters in summer the waters of the Gulf Stream are relatively extremely warm (64°4°, 68°, and 69°8°), while those of Cabot's current are relatively

cold (42.8° , 44.6° , and 46.4°), and the waters of the Polar current vary from 46.4° to 31.8° . On the Iceland banks the temperature of the surface water in May is 46.4° , and on the edge of the plateau 44.6° and 41° . In September, between the surface and 38 fathoms, the thermometer marks 53.6° .

We have still to consider the Atlanto-Saharan banks. Their temperature is anything but constant; it may be considered as a kind of compromise between the temperatures of the three parallel currents, cold, lukewarm, and warm, which skirt the coast. The cold current, between the 15th and 21st degrees of North latitude, presents the following characteristics: temperature in December, 60.9° ; March, 62.74° ; May, 64.47° ; August, 66.32° ; October, 69.85° . This current is the nearest of the three to the mainland. The tepid current, which flows alongside, has a winter temperature of 71.6° ; in summer it rises to 73.47° and 77.03° . The warm current, which affects only the open sea, maintains a constant temperature of 80.6° to 82.4° all the year round. It is easy to understand that the temperature at any given point or season may vary very widely. It depends upon the west winds, which drive the warm water into the proper belt of the cold current, or upon the east winds, which produce the opposite effect. Let us always remember, too, that in respect of their latitude the waters of the Atlanto-Saharan banks are decidedly cold.

II

Between density, temperature, and depth there exists a relation of capital importance, which may be denoted by the symbol nS_4^{θ} , which represents the weight of a litre of sea-water, S_4 , taken at a depth of n metres, with

its temperature *in situ* of θ degrees.¹ The litre of sea-water thus understood is not an inert quantity, but an active, indeed, I had almost said a living, thing, obeying Marsigli's law, which is formulated thus. Sea-waters travel from layers having a low nS_4° towards levels having a high nS_4° . I must ask the reader to pardon me for giving a somewhat obscure explanation, but I cannot otherwise explain the properties of which I have to speak.

Thanks to this law, which he has developed and elucidated, M. Thoulet has been able to achieve the synthesis of oceanic circulation. The liquid mass of the ocean is divided horizontally into two superimposed regions; one contained between the surface and a superficies about five hundred fathoms below the surface, in which the circulation of the waters takes place with a maximum of activity; and one contained between the said superficies and the bottom, in which, except in rare and even doubtful instances, there is no circulation whatever. In the first region the currents, at any one point or along any one line, may vary in direction and in intensity. Moreover, while on the subaerian soil all currents of water flow down their inclined beds, submarine currents flow upwards from the lower regions of their beds. Evaporation being more active at the equator than at the poles, the waters advance from the poles towards the equator. The thickness of the liquid layer evaporated at any one

¹ The unit of volume of sea-water, the litre, at the fixed temperature of zero Cent. or 32° Fahr., has a certain weight, variable in various specimens, according to the quantity of salts in solution, and which, evaluated by reference to the weight of the litre of distilled water at the temperature $+4^\circ$ Cent., which is that of its maximum density, is the absolute density, S_4° , of the specimen.

point of the ocean thus assumes the greatest importance in this respect, for it indicates the progress of the currents and explains the rising of waters to the surface. This is not the vertical movement from bottom to surface of a deep sheet of still water, but a sort of lowering, by evaporation, of the surface of the sea itself, which is continually compensated by a general rising of the subjacent waters.

The variations of the symbol nS_4^0 are not the sole causes of oceanic currents. They are in evidence everywhere, but they do not constitute a unique mode of movement. Other causes are the rotation of the earth, the tides, and the winds. It has been calculated that a mass of water 1,350 fathoms in depth would be animated by a movement from east to west below the equator and from west to east in higher latitudes. The oscillation of the liquid mass, provoked twice daily by the attraction of the moon and the sun, has the effect of producing a double node of undulation separated by two depressions. From this, especially in the shallower seas in the neighbourhood of continents, results a regular progressive movement of the waters striving to pass, in order to re-establish the level, from the crest to the hollow, from the hollow to the crest.¹ Finally, the winds

¹ As a matter of fact such a tendency would obviously be a purely static tendency, opposed to and in equilibrium with the force of gravity. That is, the water *tends* to flow from the crest to the level but does not do so, or there would be no tide. The actual course of tides in shallow waters is easily understood. The waters become deeper, or in other words the crest of the wave rolls over them, and more water is required that the wave may rise and pass on ; this extra water is pulled over the surrounding level, to flow back when the tidal pull has passed. The pull of the moon causes the tidal stream to flow ; the pull of the earth, or the weight of the water, causes it to ebb.—[TRANS.]

impart their own movement to the surface waters of the sea.

The physiology of the North Atlantic is dominated by the Gulf Stream. At its emergence from the Gulf of Mexico it measures 36 miles in width, 200 fathoms in depth, and runs at the rate of 6 or 7 knots ; its temperature is 86° to $89\cdot6^{\circ}$. Off the coast of France and of Iceland it has become an enormous river, 360 miles in width and over 500 fathoms in depth. It has become colder and less swift ; its pace has fallen to a bare 4 knots, while the temperature does not exceed $60\cdot8^{\circ}$ or $64\cdot4^{\circ}$. It is probable that the Gulf Stream sends a branch up the Channel ; it certainly gives rise to a backwash as far as Cape Finistère. The Rennell current—for such is its name—runs along the northern coast of Spain into the heart of the Bay of Biscay, then, suddenly turning towards the north-north-west, it sweeps the French portion of the continental plateau and flows northward towards Ireland, and perhaps as far as Iceland. In the latitude of the Gironde it sends off circular eddies to the right, which tend toward the south.

For a long time it was believed that Iceland was surrounded by the Gulf Stream as by a ring. The reality is more complex. The Atlantic waters of the stream divide, to the west of the Wyville Thomson ridge—at the island of Rockall, to be precise—into two unequal branches, flowing towards the north-east ; one passes between the Shetlands and the Farøes, and is by far the more voluminous of the two ; the other, which is very much smaller, smaller even than the Irminger current, crosses the ridge between Iceland and the Farøes. So much for the warm currents ; let us now consider the cold currents. The Polar current

descends from the north-east towards the south-west. Having reached the Wyville Thomson ridge, it runs under the warm current, and sends out a thin stream of water which overlaps the latter in the form of a narrow ribbon in the supra-litoral zone of the Icelandic plateau. A vertical section of the ocean in this region would show, between the surface and the summit of the ridge, a warm layer and a cold layer, each of variable depth and flowing in contrary directions. From this arrangement it follows that the warm stream becomes cooled and the cold stream grows warmer. Sometimes the latter predominates, sometimes the former, but as the Wyville Thomson ridge forms a constant barrier there is always an inevitable mixture of the streams. In the winter, moreover, throughout the entire Icelandic plateau we find vertical convection currents, which maintain a temperature of from 44.6° to 46.4° , although at the Westmann Islands the atmospheric temperature falls to freezing-point. Thus Iceland, according to the phrase employed by M. Cligny, plays the part of a two-way tap, which emits turn by turn or simultaneously warm and cold water in variable proportions; and the Gulf Stream in the northern Atlantic "does not assume the definite and typical form of a river, but of an eddy-like circulation subject to oscillations which are more or less extensive according to the time of year."

The physiology of the North Sea depends upon the following general data. The North Sea receives, by the submarine channel which passes between the Shetlands and the Farões, the warm waters of the Atlantic, which, as has been proved, are mingled with large quantities of Mediterranean water which has come through the Straits of Gibraltar. The currents which reach it from the

north are certainly colder, but they are by no means glacial. For this reason the waters of the Norwegian dike and the Skagerack never become very cold and always exhibit a southern flora and fauna. It must be remembered, however, that in winter the cold, almost brackish waters of the Baltic spread over a great part of the North Sea and depress its superficial temperature. The Channel brings it the warm, salt currents of the Atlantic and the Mediterranean, and the German rivers their brackish waters.

III

The tidal currents originating in the open sea merely accentuate the factors which have already been explained. There are two tidal waves in the North Sea. One progresses at a speed of eight to nine knots past the north of the Shetlands and the north of Scotland (between the latter and the Orkneys). The second, which carries only a twelfth of the volume of water, arrives by way of the Channel twelve hours later. It takes eight hours to cover the distance from Brest to Dunkirk. The two waves meet before the Thames, resulting in races, eddies, back-washes, and shoals (the Thames Bank, the Belgian shoal, the Goodwin Sands, &c.). The Dogger Bank rises in the midst of the larger eddies, which cover it with material drawn from all parts of the North Sea. The great Atlantic tidal wave, starting from the 33rd meridian, reaches the continental plateau at the end of some three hours.¹ An hour later it is in the Channel and the Irish

¹ The amplitude of the tidal wave is very small in the open sea and is rarely more than 3 feet on distant islands or in inland seas. It reaches its maximum in deep bays, straits, and estuaries.

Sea. At the end of five hours it reaches the Hague dike ; at the sixth hour it passes Barfleur ; at the seventh it fills the Bay of Calvados ; at the eighth it rounds Cape Antifer ; at the ninth and the tenth it washes the coast of Upper Normandy and Picardy ; at the eleventh it enters the Straits of Dover ; at the twelfth it is checked at the level of the Thames by the tidal wave which has travelled from the north.

This explanation is too systematic to be complete. It supposes the coast to be perfectly rectilinear, which is far from being the case. Hence back-currents, eddies, and divided currents. These I will endeavour to localise in the following table :—

I.

BEFORE HIGH-WATER AT CHERBOURG.

Time after.	Lines of Encountering Currents.	Lines of Separating Currents.	Slack Water.
5.	Start Point— Guernsey.	Dungeness— Authie.	Slack water.
4.	Bridport— Hague.	Thames— Dunkirk.	„
3.	„	London—Ostend.	The open sea enclosed by lines drawn from Portland to the Casquets — Brighton to Port en Bessin.
2.	Hastings— Fécamp.	„	The open sea off Dungeness and Antifer.
1.	Hastings— Somme.	Off Eddystone— Ile de Batz.	„
High-water at Cherbourg.	Dungeness— Somme.	Lizard—Perros Guirrec.	Cherbourg.

II.

AFTER HIGH-WATER AT CHERBOURG.

Time after.	Lines of Encountering Currents.	Lines of Separating Currents.	Slack Water
1.	Dungeness.	Eddystone—off the Minquiers.	Some miles to the east of this line.
2.	Dover—Dunkirk.	Start Point—Hague.	Some miles to the east of this line—Baie d'Isigny.
3.	London—Ostend.	„	The sea contained by lines drawn from Portland to the Casquets and Portsmouth to Barfleur.
4.	„	Beachy Head—St. Valery-en-Caux.	Dieppe.
5.	„	Hastings—Tréport.	„
6.	Plymouth Bay—Paimpol.	Hastings—Somme.	„

As we see, the water is flowing in some parts while it is receding in others. In this regard it is interesting to study the Bays of Granville and Calvados, which are separated by Cotentin. The diagram (Fig. 2), which I have constructed according to data presented by M. Hédouin, shows that the Atlantic flux fills Granville Bay and that the latter overflows into Calvados Bay, which in turn empties itself into the former. The chief effort of the Atlantic is brought to bear upon Granville Bay, which is never at rest. It is traversed by powerful currents with an average flow of 2·6 knots, which through the Hague channel increases to 9 knots. Calvados Bay, on the other hand, is calmer; the average pace of its currents

FIG. 2.—Counting from the periphery to the centre, the first belt represents the Atlantic, the second Granville Bay, and the third Calvados Bay. H.W.Ch. denotes the hour of high tide at Cherbourg. The arrows a, b, c, d, e indicate the direction of the currents. The diagram is to be read from the point: 6 Hours.

does not exceed 1·9 knots. The reader will see later on what conclusions may be drawn from all these facts.

For the same reason I will devote a few lines to the vertical currents of which M. Nathansohn has written. There are such currents to the east of the Rejkjanaes ridge (in the south-west of Iceland), in the Straits of Messina, and in general on the borders of hot and cold currents.¹ Vertical movements are perceptible chiefly in the open sea. Near the coast they are hampered by the affluxion of the fresh water of rivers and by the mechanical action of the coast, which causes the layers of water inshore to sink to the lowest depths of the currents which impinge upon it. Natterer has proved the reality of ascending currents in certain parts of the Mediterranean by noting the proportions of nitric acid and bromine contained in the different layers of water. Nathansohn, moreover, analysing the water of the western Mediterranean basin, has often found the same salinity and temperature at the top and the bottom. On April 7, 1909, the Prince of Monaco obtained the following data between Nice and Corsica :—

Depth.			Temperature.			Salinity.
0	...	...	54°8'	...	...	21°32'
7,190 feet	...	...	55°34'	...	...	21°31'

The cause of these ascending currents nearly always resides in the different temperatures of different layers. In summer the sunlight warms the surface layers of the sea. When the winter comes the water of these layers becomes colder and so heavier, and sinks until it finds a layer of the same temperature and the same specific weight. Hence the ascending current. M. Nathansohn

¹ Also in the Atlantic, under the equator, between the Admiralty Isles and the Caroline Isles, between Hawaii and Tahiti, and to the north of Ascension.

mentions another cause. Currents flowing in opposite directions, he says, can transmit their movement to the masses of water situated between them, whence a compensating current ascending from the bottom. Vertical compensating currents are frequent in the polar and the equatorial regions. In the Mediterranean there are possibly cyclonic movements. The lighter water would be at the periphery of the cyclone; the more concentrated water is in the centre, in a vertical column. It is in the centre of such cyclones that Pettersen sees the formation of the "abysmal" water of the Irminger Sea and Nansen that of the Norwegian Sea.

IV

I have now spoken of the currents of the North Atlantic, the Channel, the North Sea, and the Mediterranean. I must now proceed to deal with those of the Moorish coast. The transition is natural enough, for there also the Gulf Stream plays an important part.

In the southern hemisphere the average temperature of the sea is lower along the western coasts of America, Africa, and Australia than on the eastern coasts of the same continents; in the northern hemisphere the converse is true. "All navigators," writes M. Gruvel, "who have sailed the Moorish waters and the Bay of Senegal know that there is a current running from north to south all along this coast, and apparently almost exactly parallel to it. This current is often a powerful one. It is originally formed by a branch of the Gulf Stream, which, having skirted the coast of Portugal, forming what is known as the Great Canary current, splits up at an indefinite and probably variable point off the Moorish coast into two secondary currents; the western branch, much the more important of the two, going to form the

great North Equatorial current, while the eastern branch follows the west coast of Africa as far as the Gulf of Guinea, where it encounters the contrary Guinea current coming from the west and the south-western African current, or the Benguela current, coming from the south, to form the south equatorial current."

Now let us go into details for a moment. At the level of Cape Blanco the north-to-south current breaks up, as will be remembered, into three currents which are differentiated by their temperature—a cold current washing the coast, a warm current far out at sea, and a tepid current between the two. The first gathers its waters from the North Atlantic, by way of the Gulf Stream, and from the Mediterranean; the second and third draw their waters more especially from the tropical Atlantic. The cold belt and the tepid belt have an average speed of one knot per hour; the speed of the warm current varies from ten to twelve knots in the twenty-four hours. When the winds blow from the west they force the cold and even the tepid current upon the coast; they then form a back-current (the counter-current of Arguin, *vide* Gruvel), which runs up towards the Greyhound Bay and flows round the Arguin bank. As for the tidal wave, it progresses from south to north, enters Greyhound Bay between Cape Blanco and the western slope of the Arguin bank, strikes against the eastern shore of the bay, runs along that shore, and overflows to a slight extent by the shallow channel which lies between the eastern slopes of the bank and the shoals of the African coast. From this results a number of eddies, turning towards the south of the bank. At the moment of ebb-tide the water runs out of Greyhound Bay at two and a half knots per hour, winding round the western slopes of the bank,

V

Temperature and salinity are not merely the two principal agents of oceanic circulation ; they are the factors which make life itself possible in the depths of the sea.

We use the term *plankton* to denote a heterogeneous mixture of living creatures, comprising very minute adult species, both vegetable and animal, the larvæ of these and of larger species, and the eggs of all kinds of vegetables and animals, which, although sometimes having a movement of their own, are carried along by the mass of the water containing them. The collective term *plankton*, in short, denotes the "living dust" which is scattered over the ocean ; the "living emulsion" of which I spoke on the first page of this book. We shall comprehend the importance of this element if we remember (1) that the majority of pelagic species¹ remain pelagic during all stages of their existence ; (2) that nearly all marine species, of whatever kind—corals, starfish, sea-urchins, sea-worms, molluscs, fish, &c.—are pelagic during the early stages of their youth ; and (3) that the vegetable plankton, which is by far the most abundant, transforms the inorganic substances of the ocean into living substance ; it is the vegetable plankton which, with the salts dissolved in the water, creates life ; and it is plankton which serves to nourish the entire animal population of the seas.

Vegetable plankton is composed of bacteria and adult microscopic algæ, the latter belonging to three primary groups : Diatomaceæ, Peridinaceæ, Cyanophyceæ. The Diatoms are algæ possessing a fragile flinty carapace, which constitutes a veritable suit of armour. Their

¹ The terms *planktonic* and *pelagic* are synonymous.

forms are widely varied : some are spherical, some cylindrical, some spindle-shaped, &c. Sometimes they are united in circular or rectilinear colonies. The Peridinaceæ may be recognised by their long mobile cilia, which are known as flagellæ. They are clad in a thick cuirass, which is ornamented with three or four very fine spiny projections. The Cyanophyceæ are filamentous algæ. Besides these three groups there are the green algæ, which are associated in colonies, and are bathed in a gelatinous *magma*. It goes without saying that the eggs and spores of these tiny organisms also form part of the vegetable plankton.

Animal plankton is composed of tiny microscopic creatures belonging to the Protozoa, and ciliated or flagellated ; Radiolaria, with finely worked flinty shells, and Gliberiginae, with smooth calcareous shells. It also contains immense quantities of tiny crustaceans, invisible to the naked eye, and of Copepoda in particular. The Copepoda have elongated segmented bodies, but no carapace, and carry two pairs of swimming antennæ. As in the vegetable plankton, the eggs and larvæ of all these little organisms go to make up the mass of plankton together with the adult organisms. Plankton also contains the eggs and spores of almost all the marine algæ of the continental plateau, the eggs and larvæ of nearly all the marine invertebrates, even of those which when adult are the most securely attached to the rocks or hidden in the sand ; and the eggs, the larvæ, and the fry of many fish, even of those which, like the sole, spend their adult life upon the bottom. If I may be allowed the comparison, plankton is like a vast city full of inhabitants who are born, live, multiply, and die, and also of passing visitors, who come from all parts of the world in their infancy and return thither as they grow up.

Although the specific weight of pelagic creatures is always a little higher than that of sea-water, they remain at the surface or at an inconsiderable depth. This is because most of them possess vibratile cilia or flagellæ or locomotive appendages. Moreover, as the water is never calm, it holds passive bodies, such as eggs, in suspension. Then we must not forget that we have to do with living bodies, which assimilate food, breathe, and perform work. Plankton is often more abundant on the surface in the night than in the day. "The experimental studies of Brandt," writes Professor Pruvôt, "have explained the mechanism of these movements among creatures devoid of motive power, such as the Radiolaria. Among the Radiolaria of which we have experience, the floating equilibrium is maintained by the fact that the excessive weight of the central capsule is corrected by the lesser density of the gelatine which constitutes the extra-capsular portions, and of the liquid which fills its vacuoles. Any stimulus or excitation causes the contraction of the vacuoles and the expulsion of their liquid ; hence an increase in density and a descent to the bottom. Then, the perturbing action having ceased, the vacuoles become filled with fresh liquid, and the animal re-ascends. In the open sea these creatures are driven from the surface by the mechanical stimulus due to the movement of the waves, or by a thermal stimulus such as the daily warming of the surface of the sea ; they descend slowly, refill their vacuoles in the deeper layers of the sea which are at rest and are not warmed by the sun, when they once more float to the surface, only to sink again, and so forth, until the exciting cause has disappeared, when they remain at rest upon the surface." In the case of the Copepoda the oscillatory movements are due to the temperature alone.

At the beginning of the first chapter of this book I gave certain approximate figures relating only to certain units of the planktonic mass. Let us now consider other units. We have seen that the Skagerack, in summer, contains nearly 300,000,000,000 fertile eggs. In the course of February and March the North Sea contains from 65 to 75 trillions of eggs and larvæ, and during the spawning season, some 150 trillions of eggs of the herring alone. In the neighbourhood of the Bermudas the mass of living jelly in suspension amounts to 5 cubic centimetres per square metre of oceanic surface. "Off the coast of Iceland and of Newfoundland, where there is a great abundance of fish," says Professor Mangin, "we find 220 cubic centimetres per square metre of surface; there is thus an enormous quantity of living jelly down to a depth of 50, 100, and 200 fathoms. In another experiment 2 cubic metres of sea-water was filtered; the residue consisted of 5 millions of peridinaceæ, 630,000 diatoms, 80,000 copepoda, and 63,000 animals of various species. Let us now consider the waters of a bay notable for its wealth of fish, in the neighbourhood of the Cape of Good Hope. In a column of water 1 metre square and 18 metres deep, $5\frac{1}{2}$ litres (9.66 pints) of living jelly was found, containing 8,200 millions of bacteria and a vast number of miscellaneous organisms. Stettin Bay, in the Baltic, which is very rich in marine organisms, has yielded in one cubic metre of water 9,653,000 filaments of a Cyanophyceæ, which gave a very characteristic green colour to the water." The variability of plankton is remarkable. In the Baltic, for instance, in the month of April, about 44 millions of organisms were found per square metre of surface; while in October the number was about 147 millions. The proportion varies notably according to the seasons. It

varies firstly by reason of the evolution of the organisms themselves ; also because large quantities of plankton are eaten by marine animals ; these two causes incessantly weigh one against the other, and maintain the quantity of "living matter" scattered through the ocean at an almost constant level at any one season of the year. An infinitesimal crustacean, the *Cetochilus*, often forms enormous shoals which give the water a reddish tinge for many square miles together. The fishermen of the Firth of Forth give the name of "maider" to swarms of similar crustaceans. The Red Sea owes its red colour to accumulations of reddish algæ ; the Baltic and the Greenland waters owe their greenish tinge to swarms of green algæ. At the beginning of the summer the Norwegian sea turns brown on account of the arrival of the brown spores of diatoms. In April and May whitebait, a mixture of young sprats, herrings, and sardines, swarm in the bay of the Seine and along the English estuaries. In spring the *poutina*, a mixture of atherines, small sardines, and aphyes, invades the inlets of the Ligurian coast. Such instances might be multiplied indefinitely.

The colossal number of pelagic creatures is due to the intensity of their powers of reproduction. The protozoa multiply with a rapidity that defies calculation. The process of reproduction is simple in the extreme ; it usually consists in the division of one creature into two identical creatures. Sometimes there are spores,¹ which develop without the aid of fertilisation ; sometimes there are eggs, which only develop after fertilisation. All the marine invertebrates and the fish produce eggs ; and in respect of these eggs I have already given significant

¹ Simple undifferentiated cells, which at a given moment detach themselves from the adult and reproduce it by a process of division.

figures.¹ Thus the mass of life distributed throughout the ocean is in a condition of perpetual renewal, and constitutes a perpetual reserve of matter and of energy.

VI

Now the time has come to consider the distribution of plankton. We can distinguish two regions: the region of neritic plankton and that of oceanic plankton. The first corresponds with the in-shore and off-shore districts; it therefore comprises the plankton of the waters of the continental plateau. The second comprises the plankton of the open sea. The former does not descend lower than 100 fathoms; the latter may sink to the lowest depths. The limit of the penetration of light—that is, practically, from 100 to 130 fathoms—marks the limit of penetration of vegetable plankton, as there can be no vegetation without light. Here is the result of a haul with a wide-mouthed net made by the Prince of Monaco in latitude $45^{\circ}30'$ N., $5^{\circ}5'$ W. longitude, on the 6th September, at a depth of 800 fathoms, and above a depth of 2,500 fathoms: innumerable radiolaria, violet medusæ, molluscs, innumerable little fish of the Syngnathus (pipe-fish) family, and 52 species of crustaceans. To sum up, we find plankton everywhere, but there is a relation between the locality and the nature of the plankton. This essential truth must be emphasised. The microscopic shells at the surface which fall to the bottom differ according to the prevailing currents and temperatures. It therefore follows that there are centres of planktonic production whence a given flora and fauna overflow to a less or greater distance. It seems to be proved that each system of currents transports its particular flora and fauna. By *plankton-element* we mean a methodical grouping of

¹ See p. 22.

vegetable and animal forms having common attributes, and of which it is convenient to estimate the degree of evaluation. Neritic plankton is by definition distinct from oceanic plankton : however, it often happens that the two become mingled and interpenetrated. There is a great analogy between the pelagic flora and fauna of the subtropical Atlantic and those of the Mediterranean. The water of the glacial regions, charged with its peculiar plankton, reaches the Mediterranean and perhaps even the Red Sea. The dead plankton which falls from the surface is absorbed by the creatures at the bottom. These latter, moreover, develop according to the direction of the currents, and their number is in direct proportion to the quantity of plankton carried by the currents.

The opinion which I have just cited—namely, that there are centres of pelagic dispersion—is supported by the well attested fact that there are local accumulations of plankton. There is such an accumulation in the Red Sea. Along the Norwegian coast, in May and June, the plankton is scanty ; but shortly afterwards large accumulations of diatoms appear, which give the sea a brown tint. They are developed from spores contained in the icebergs which come down from the North at this season. This is one of the means by which “pelagic swarms” are formed. Another means is the encounter of two currents loaded with plankton. Such swarms have been observed off Concarneau by the *Princess Alice*. They consisted of bands of plankton parallel to the line of the swell and to one another. Each belt was from 2 to 3 feet wide, 25 to 30 feet long, and 3 feet in depth. In the open ocean, thousands of miles from any land, colossal agglomerations of pelagic fish are found, which cover whole seas. Here is another example, which will serve as a synthesis of the preceding data. In the

North Sea, between Bergen in the east and Bodö in Iceland in the west, the waters are inhabited by a host of copepoda belonging to the family of the Calanidæ. The Calanidæ form distinct zones, which exhibit no solution of continuity, constituting an unbroken cycle. There are three zones : the zone of eggs and larvæ, the zone of young fish, and the zone of reproductive adults. This, says M. Damas, "indicates that the species maintains itself by the existence in these regions of a circulatory current, which periodically carries with it a certain proportion of the individuals scattered over the surface of the ocean, and carried onward by the perpetual movement of the waters. The existence of a central and special plankton zone is a new proof of the existence of this rotatory circulation. The well-known example of the Atlantic Ocean and the Sargasso Sea shows that this instance is not unique." Thus the complete cycle of the life of the pelagic species is connected with the complete cycle of the currents, and this double cycle is the symbol of the rigid correspondence between the species and its habitat.

Professor Clève has attempted to establish planktological charts from data afforded by the various currents. He distinguishes several separate regions in the North Atlantic. All the eastern quarter of the Atlantic (including the waters of France, England, Spain, and Ireland) is populated by diatoms of the genus *Thalassiosira*. The western quarter (the waters of the United States, Canada, Newfoundland, Greenland, and Iceland) is peopled with diatoms of the *Rhizosolenia* family, while to the east of Iceland are found diatoms of the genus *Thalassiothrix*. The North Sea also exhibits several planktonic areas : firstly an urn-shaped area, of which the foot rests upon the Flemish coast, while the sides touch the north of

Denmark on the right and the Shetlands on the left ; the bottom of the urn is thus on a level with the Dogger. This is the zone of the green algæ of the *Halosphæra* genus. Then inside this urn-shaped area is a smaller area of similar shape, but without a foot ; there is the zone of *Peridinaceæ*, of the *Coscinodiscus* family. Finally, filling up the second urn is a homogeneous mass of *Peridinaceæ* of the *Ceratium* family.

It will, of course, be understood that Clève's charts represent an approximation, an average ; in reality plankton is subject to annual variations. These variations are ushered in by a superficial sterility of the waters. Among their causes, in the spring, is the rush of the Atlantic waters, which at this season turn towards the northern hemisphere along the eastern shores of the ocean ; in autumn, the extension of the Gulf Stream towards European waters ; and in winter, the flow of the arctic waters, which make towards the south-east.

VII

In the course of these pages I have often had occasion to speak of the formation of plankton. I must now indicate the principal conditions of its formation.

Shallow seas are richer in plankton than deep seas, and the seas of the tropical and the temperate zones are on the whole poorer than the polar seas, although the contrary might be expected from the analogy of terrestrial vegetation. The cold currents are thus more favourable to the development of plankton than are the warm currents. In general, at the limits of both hot and cold currents, there are considerable agglomerations of plankton.

The fact is that between the two ascending currents are produced, which are the best agents of pelagic

pullulation; and this takes us back to the vertical currents of Nathansohn. Wherever these currents exist, there plankton abounds. The Straits of Messina are celebrated in this respect. The Irminger Sea is the richest in plankton of all the waters visited by the "Plankton Expedition." In the Atlantic, almost under the equator, although the temperature of the water is over 77°, there are enormous accumulations of plasmon. The *Challenger*, between the Admiralty Isles and the Carolines, and Hawaii and Tahiti, gathered enormous quantities of diatoms in the warm superficial layers of the sea. The waters to the north of Ascension exhibit the same wealth of organisms; and they, like all the regions mentioned, excepting the last, occupy the centre of a cold ascending current. I repeat that cold water is necessary to the formation of plankton, but it is not absolutely indispensable, and the action of a single vertical current often suffices. The explanation of this phenomenon is simple. The struggle for life is more intense at the surface; hence a dearth of alimentary material. But let us take the case of a vertical current: we find that alimentary matter which has sunk elsewhere is thrown up to the surface once more, and thus makes the surface habitable. I must draw attention to two important conditions relating to the lines of encounter and separation of tidal currents in the open sea, and to suspended alluvial matter. It may be laid down as a general thing that wherever two ocean currents come together or separate there will be abundance of plankton. I have verified this law in the Channel, and in this connection I have carefully located the lines of encounter and separation of the Channel currents (p. 80). We see, then, that plankton does not abound in extremely rapid currents, and are able to

understand why Calvados Bay is richer in plankton than Granville Bay. It is true that the alluvia of the Seine contribute a certain amount of material to the former bay ; but they are infinitely less than those of the great German rivers, which throw their deposits as far as the Dogger, or than those of Cabot's current.

To sum up, plankton and current are synonymous. This formula has the advantage of connecting the oceanographical study of plankton, which terminates here, with the chemical study of it, the principal elements of which I am about to enounce.

VIII

Vegetable plankton is the prime cause of chemical action in the ocean. This it is, as we know, that transforms into living material the inorganic substances dissolved in the water. The animal plankton lives at the expense of the vegetable plankton, which it absorbs. The larger marine animals consume either vegetable or animal plankton, or animals smaller than themselves which are nourished on plankton. Such is the general scheme of oceanic life. The quantity of vegetable plankton is in direct proportion to the mass of soluble nutritive substances. The marine plants would nourish themselves upon these soluble substances until the latter were exhausted, were it not that they are constantly renewed by the perpetual action of the currents. It is to this perpetual movement of the waters that the development of vegetable plankton is due. Naturally an equilibrium is produced between vegetable and animal plankton (as M. Gruvel has proved in his experiments off the coast of West Africa), so that the regions richest in vegetable plankton are often the poorest in animal plankton. In other words, the

quantity of plankton, according to M. Nathansohn, depends solely upon the dynamic equilibrium of two antagonistic processes: the production of algæ and their destruction by physical and animal agencies. The physical agencies are of various kinds: excessive or defective salinity of the water, too high or too low a temperature, &c. As for the animals, they may be large or small, but all the small animals, and without exception all fry or larvæ, feed upon plankton, and we may at once assert that those regions which are richest in plankton, and especially in vegetable plankton, at the moment of spawning, are also the richest in fish.

It is not only the soluble salts which are absorbed by vegetable plankton in order to fabricate living matter; the whole series of mineral substances are also required, of which the most important are the inorganic azotic compounds. These latter (nitrites, nitrates, and ammonia) derive almost entirely from the putrefaction of the albuminoid matters furnished by the animal and vegetable series themselves during their life or after their death. The process is extremely pretty. It is carried out by the nitrifying bacteria. By the aid of oxygen they transform the ammonia into nitric and nitrous acid. But the azotic products, soluble in water and incessantly washed into the sea, century after century, by the rivers and the rains, would finally poison the water and render life in the ocean impossible. Brandt, whom I cite as quoted by Pruvôt, has demonstrated, by a calculation based upon the alluvia of the Rhine, that the total mass of oceanic waters must receive from the rivers an annual contribution of azote which is not less than 1 gramme per 33,000 cubic metres, or 3 grammes per cubic metre in 100,000 years, or 30 grammes in a million years. From this one can see that the ocean no

less than our cities requires a system of hygiene. How is this system to be provided? Once more by the bacteria; they decompose the excess of nitric acid and restore the free azote to the atmosphere. The remainder is utilised for the production of plankton. I have summarised all these successive transformations in the following table :—

It would be extremely interesting as a matter of oceanic economics if we could estimate the total production of each portion of the sea. The sea produces as much as it can produce; neither more nor less. Consequently the distribution of the units of plankton is practically uniform over enormous tracts of ocean, wherever the composition of the water and external circumstances are the same; and the total mass of large and utilisable animals, which in the last resort have no other food,

cannot exceed the total mass of plankton itself. We might therefore legitimately estimate the total productivity of any marine area by the method of Hensen ; that is to say, by measuring the amount of plankton taken at different points under different conditions and at different seasons ; but we must make our count with the utmost patience, in order that we may distinguish in our measurements and our calculations the producers (algæ) from the consumers (animals). The quantity of plankton contained in the water at the beginning of the year represents, in fact, a capital sum of which the interest only is consumed during the course of the year in the shape of products, and which should be still intact at the end of the year.

As an example, let us estimate the number of seals on the Californian coast at 25,000. Each seal eats about 44 lbs. of fish per diem. If we admit that 44 lbs. of fish are the product of 44 lbs. of plankton daily, the 25,000 seals indirectly consume about 401,500,000 lbs. of plankton. Before the end of the year this enormous quantity is restored by recuperation.

When we have a perfect knowledge of plankton we shall be able to determine whether there is any possibility of augmenting the fertility of the seas by human intervention, as cultivators enrich the soil with manures. But hitherto we have not reached the necessity of such a procedure, judging, at least, from the North Sea.

Brandt has shown that it receives annually per cubic metre 14·85 milligrammes of azote in combination and available for use (7·8 milligrammes from the rivers, 6·3 from the rains, and ·75 from the sewage of cities), or in all 487 millions of kilogrammes (nearly half a million tons), while the tribute taken in the form of comestible flesh amounts only to 16 millions of kilogrammes, corresponding to 875 millions of fish captured.

We have now briefly yet thoroughly considered all the principal elements of the life of the fish. We have dealt with the fish, its needs, and its instincts ; we know where and in what manner it can find in nature the means of satisfying them. The fishing-ground is now a thing of perfectly definite qualities ; it is a relatively shallow region, slightly broken by hollows and valleys, and rich in foodstuffs. Moreover, all the data which we have been considering have been furnished by Nature herself, and it is Nature that we have watched at her work. We must now return to man, and must ask ourselves what part he plays in the economy of the ocean.

CHAPTER IV

FACTORS OF DESTRUCTION

- I. The depopulation of our native waters—The impoverishment of the North Sea. II. Natural causes of such depopulation: sudden migrations, modifications of the sea-bottom, voracious fish and mammals. III. The damage done by seines and drift-nets—The otter-trawl in relation to flat-fish and spawning-ground. IV. The ox-net or Mediterranean bag-trawl and the shrimp-trawl—The small fishers responsible.

FISH have always been a plentiful foodstuff. The men of the Neanderthal or of Cro-Magnon, bent over the lake near which their huts were built, or the little bay enclosed by cliffs which had served them for refuge on the conclusion of a fight, threw in their lines to take a catch of fish, a nourishing and abundant foodstuff. For a long time they would fish there; for a long time they would rest, for all the nations of mankind are—or were—ruled by the law of the least effort. But in time the lake or the little bay would become exhausted, and would no longer suffice to feed the tribe. Then the tribe would migrate and settle elsewhere, and the same story would begin again. It is a story which is not yet completed. Look at the fishers of the French coast. They put to sea in their little boats and fish always in the same place, almost under the windows of their cottages. The sons do as did their fathers; the

fathers followed the example of their ancestors. And sooner or later the little bay has grown empty of fish. Then the large bay, the distant gulf have been exploited, and they also show signs of exhaustion. Any fisherman will tell you the same thing: "Twenty years ago we could catch all the fish we wanted, but now the turbot and soles have disappeared!" And the depopulation of the fishing-grounds already assumes the aspect of a social and economic phenomenon, as a consequence of the law of the least effort.

I

As long ago as 1880 M. Bouchon-Brandely declared that the impoverishment of the shores of the Mediterranean was an undeniable fact. Shortly afterwards MM. Roy de Lonlay and de Lorgénil made the same assertion in respect of the Channel. Four years later the "Statistics of Maritime Fisheries" made the following statement: "In the neighbourhood of Roscoff the disappearance of large fish, rays, congers, &c., continues, as does that of the crustaceans. In the neighbourhood of Marennnes the larger fish, which left our coast waters years ago, are keeping to the open sea, in depths of 35 to 50 fathoms. The fishery there is productive, and also has the advantage of not being destructive, as are the fisheries pursued close inshore. In the neighbourhood of Dax the hake fishery, which is the principal industry of Cap Breton, has been particularly disastrous, the fish persistently and increasingly deserting the coast, and the fishermen being without the means of going in search of them in the deep bottoms. In the neighbourhood of Port-Vendres the rarity of the principal species of fish has forced the fishermen to apply themselves in a more constant fashion to a languishing

industry. In the neighbourhood of Nice fish of the sedentary species are becoming more and more rare. In the neighbourhood of Roglione and Bastia the 'syndicate' of Calvi, whose members are engaged almost exclusively in the crayfish fishery, have suffered more than most, so much so that twenty of them have given up their calling and have obtained work on the mail-steamers. The falling-off in the yield of the crayfish and lobster fisheries may be attributed to the rarity of these crustacea in the neighbourhood of Cape Corso." "In Newfoundland," writes M. Busson, "the methods of the English have so greatly diminished the abundance of the cod that the Government of St. John is to-day meditating the foundation of a centre of pisciculture for this fish."

In the Golfe du Lion the yield per kilometre of coast has fallen in twenty-four years (1880-1904) from 925 kilogrammes to 270; along the Provençal coast, from 528 to 489. The North Sea is also becoming less thickly inhabited, as a commission of inquiry appointed by the British Government has plainly demonstrated. Of twenty species of fish examined, one only—the haddock—is not diminishing; in 1906 the daily captures were 830 lbs.; in the case of other species the decrease is constant. Here are some significant figures:—

			1903. Tons.			1906. Tons.
Turbot	...	...	3,250	...	...	2,600
Sole	...	...	1,700	...	...	1,100
Ray	...	...	7,000	...	...	5,400
Plaice	...	...	40,000	...	...	22,000

In the same lapse of time the yield of flounders decreased from 155 kilogrammes per diem to 105 (342 lbs. to 231 lbs.).

The dearth of fish has naturally led to a dearth of fishermen. In 1903 the work effected by the total

number of steam trawlers was equivalent to 203,985 days' fishing. In 1906 this figure had fallen to 164,321. In short, the North Sea is being less fished because it shows actual symptoms of depopulation.

II

Naturalists and fishermen both have sought for the causes of this depopulation. These we will examine from a critical point of view, in order to arrive at a correct and practical conclusion. The causes are of two kinds: those which arise in the course of nature and those which arise from the practice of fishery; natural causes and human causes.

Let us take the natural causes first. We know that a sudden change in the temperature or salinity of the water leads to a corresponding change in the plankton, and that the fish follow the plankton. In the course of ages such changes must often have occurred. The feeding-grounds of the fish were once there and are now here: such is the simple formula of the phenomenon. It is the same when the coastwise shoals undergo alteration from the fact of new deposits or the alluvia of the rivers. For example, the drift of the waters of the Rhone towards the Golfe de Fos, a stretch of sea running from the Pointe de Beauduc to Cap Couronne, deposits there every year 16 millions of cubic metres of mud and sand, which render life impossible. When a bank of sardines or of anchovies changes its ground for one a few miles away, we hear always the same story: as the fishermen no longer find the fish where they used, for them the fish no longer exist.

This is a flight, a change of residence, and not a destruction. But we quickly come to the latter with the appearance on the scene of voracious animals: porpoises,

belugas, dolphins among the cetaceans, and among the fish the sharks and large dog-fish, of which the most pernicious are the prickly dog-fish, the blue-skins, the white dog-fish, and the squatinæ, or angel-fish; and among the molluscs the cuttlefish.¹ Porpoises give perpetual chase to the sardines, anchovies, mackerel and herring. Each individual porpoise devours an average of two barrels of fish per diem. In the Gulf of St. Lawrence gluttony of this kind destroys more than 300 millions of barrels in twenty-four hours. In 1901 the inscripts² of Baynuls, of Collioure and of Leucate were forced to abandon the fisheries on account of the porpoises. The Bretons dread them; but—extraordinary paradox—the Basques, far from having any fear of them, regard them rather in the light of dogs which put up the game. What is truth on this side of the Pyrenees is error on the other side. The belugas and dolphins, endowed with considerable intelligence, wait until the sardines are caught in the meshes of the net before falling upon their prey; the damage that they do is therefore double: loss of fish and loss of nets. On the coasts of England, some years ago, the supply of sardines was abundant; but they were destroyed or dispersed by the prickly dog-fish. The blue shark and the white shark, or *touilh*, are by no means outdone by the prickly dog-fish. In 1882 they caught in a net at Marseilles a white shark weighing just over a ton. Even if we admit, says M. Gobin, that it requires only 20 lbs. of small fish to increase the weight

¹ Sea birds also work great havoc, pursuing shoals of fish as they pass along the surface, flying-fish, &c. But it is difficult to estimate the extent of their destructiveness. Mr. Spencer Walpole estimates that voracious fish and sea-birds together devour 3,000 million herrings annually in the North Sea alone.

² Inscripts: sea-faring men, commonly fishermen, inscribed upon the register of those who may be called upon to serve in the navy.

of such a giant by one pound, it will represent a total consumption of more than 20 tons, which, if valued at a penny the pound, would be worth £186. Cuttlefish devour enormous quantities of fish inshore. They sometimes appear in phalanxes so closely packed and so voracious as to remind one of a swarm of locusts. I desire only to make a passing mention of these destroyers, by which I mean those which by their size, their muscular power, and their rapacity form a kind of aristocracy of plunderers which has nothing to fear from other creatures and which, assured by reason of its strength of perpetual impunity, has no vocation but that of securing victims. These beasts of prey destroy and kill without even restoring to man in the form of edible flesh the product of their raids. I have said nothing of the tunnies or the other Scombridæ, because they are brigands on too small a scale, whose life is often threatened by more powerful enemies ; moreover, once they are brought to land they may be transformed into good hard cash.

III

I must now pass on to the damage done by a creature far more voracious than the porpoise or shark : I mean the fisherman, and especially the small fisherman. In virtue of the law of the least resistance, the small fisherman works again and again upon the same coastwise shoals, until the day when their exhaustion no longer enables him to draw a living from them. The Central Committee of the Shipowners of France has published some very interesting data in this connection. The extension of steam trawling has been extremely rapid of late years ; the number of trawlers has doubled in the space of six years. But the field of operations has not increased in proportion ; the trawlers, with a more

numerous fleet and a more perfect equipment, have continually exploited the same old fishing-grounds. The Bay of Calvados, the small bays of Brittany and the hollows off the coast of Charente, such as the Pirlon Hole, have been worked for centuries, and are becoming impoverished.

There is scarcely any method of fishing which has not to some extent been responsible for the impoverishment of the inshore fishing-grounds. The employment of gunpowder and dynamite, and of toxic substances such as chloride of lime and other drugs, which are used in the Provençal seine fisheries, is, it goes without saying, most pernicious.¹ To such factors as these we must add effluents of soap-works and factories, which have poisoned certain parts of the Bay of Marseilles, and the outfalls of sewers. The stake-nets ought to be destroyed, as from time immemorial they have captured swarms of bream, bass, gurnards, caplin, and conger. Fishers with the curtain-net at the mouths of rivers uselessly destroy myriads of young fish. In 1890-91, writes M. Roché, the fishermen of Esnandes offered in the market of La Rochelle quantities of little soles, quite unsaleable, which one could only use as manure. In November, 1890, there were taken near the coast, in the neighbourhood known as La Fosse, soles of which three hundred pairs were required to fill a basket, and which were less than 4 inches long. The immoderate use of the seine produces similar results almost everywhere, but particularly near Auray and Quiberon. In the neighbourhood of the

¹ M. Hanriot, in 1907, succeeded in extracting from the *Telphrosia Vogeli* a toxic substance which he called Telphrosine. If a handful of this substance is thrown into the water, fish become stupefied and float to the surface. A description of the nets cited above will be found in Chapter III. of Part II. of this book.

Ile de Houat, where formerly were numbers of gilt-heads and bar in 4 to 15 fathoms of water, constant and intensive seining has resulted in their disappearance. Finally, the eel-spear and the metallic oyster-hurdle have contributed to the exhaustion of the Arcachon lagoon.

But it is trawling on the large scale, and above all the use of the otter-trawl, which has provoked the bitterest polemics, because the problem it gives rise to is not merely of a technical but also of an economic nature. The fact is that the small fishermen, who, not possessing capital, cannot make use of this powerful and costly equipment, accuse it of the most terrible crimes, and use it as a weapon in attacking the wealthy companies. It is therefore necessary to examine this question with the greatest impartiality. I shall deal with the effects of trawling upon the fishing-grounds and also its effect upon flat-fish, the migratory species, the meadows of sea-grass, the spawning-grounds, and the young fish.

A steam trawler, furnished with an otter-trawl, and working about twenty hours a day at an average speed of two and a half knots an hour, and trawling three hundred days in the year, will plough up the submarine soil over an extent of about 83,000 acres—nearly 130 square miles. Thus the 213 steam trawlers owned in France would exploit some 1,780,000 acres annually, or 2,780 square miles if they did not go over the same ground twice. In the light of these calculations, based upon the data given by M. Roché, we need not be astonished at the statements of the English Inspectors of Fisheries: "There were last year (1902) about 1,200 trawlers in the North Sea. Supposing that each vessel fished thirteen hours a day for 280 days with a net 75 feet wide, and covered 17 square miles per month, which

figures are quite normal, these 1,200 trawlers would suffice to cover twice in a year the whole of the 100,000 square miles of practicable bottom in the North Sea."

Recently the English Government has held an inquiry into the emptying of the North Sea, and the Board of Agriculture and Fisheries has published the results. Here they are in a few words. Since the introduction of the otter-trawl the number of plaice caught per diem has continually decreased. Between 1903 and 1906 the takings of flat-fish fell by 40 per cent. In 1903 the English steam trawlers landed 190,000 tons of fish, and the sailing trawlers 14,000 tons. In 1906 the numbers fell respectively to 140,000 and 12,000. On the other hand, the otter-trawl has not, as has often been pretended, the effect of frightening fish and disturbing the migratory species. No serious connection can be cited between trawling and the disappearance of shoals of herring or sardine. Moreover, in 1891 the increasingly large takes of hake in the Bay of Biscay gave the direct lie to the accusation.

Scientific research has also disposed of the mistaken idea that the trawlers, in destroying the meadows of sea-grass, also destroy the asylum and spawning-place of innumerable fish. The question assumes a double aspect. That the trawls destroy the banks of seaweed is probable; but it must first be shown that these submarine meadows are spawning-grounds. Now, there is no proof of the kind. More than a century ago, Tillet, Fougereux and Guettard, who were entrusted by the French Academy of Sciences with the elucidation of this problem, positively declared that an examination of the wrack from such "seameadows" betrayed, under the microscope, not a sign of the spawn of any fish. I myself have had occasion to examine many submarine meadows on the French, Eng-

lish, Norwegian and Swedish coasts, and I am certain that they play no part in the process of spawning. Does this mean that there are no natural spawning-grounds? By no means: but we must clearly understand what is meant by such a term.

The eggs of the majority of edible fish are pelagic, and do not come into contact with the floor of the sea. Among the species commonly sent to market only the herring and rays have submarine eggs. This simple fact should already warn us that a spawning-ground is rarely a place where eggs are laid in a great accumulation and remain until they are hatched. What, then, are the characteristics of a spawning-ground? A little while before spawning the flat-fish—the soles, for instance, from the middle of February to the middle of March—assemble at the foot of submerged groups of rocks, and, leaving their hiding-places in the sand, commence to swim within a very limited zone, after which they expel their eggs, which are dispersed at the will of the currents. This, then, is a second interpretation of the term “spawning-ground.” Here is a third. Directly they are spawned, and during the entire process of incubation, the pelagic eggs are carried away by the currents. In the North Sea, says M. Roy, the principal current along the English coast moves southward at a rate of 5 miles a day. Further to the east the current bears northward at the rate of one and a half miles. If, therefore, the eggs of flat-fish spawned in the north are carried away by the former current, they will arrive in the south in the larval state, about 60 miles from the place of their origin; and once these larvæ reach favourable surroundings (clean sand, calm waters, a proper temperature and salinity, and a sufficiency of nourishment), they settle down and begin to grow. It is the same with eggs spawned in the south

and carried by the second current, except that the young fish develop in the north. Pelagic eggs, in short, and this is a general truth, are hatched in certain propitious localities, often far distant from the spawning-place.

The spawning-ground thus appears as a *place of birth and growth*. It nearly always consists of sand, more or less muddy, with here and there projecting rocks. Sometimes it is found close to the shore, in bays and estuaries, where nourishment is abundant; sometimes it is out in the open sea, among the banks and shoals. Thus the Dutch coast and the shores of Heligoland and Lümfjord are the nurseries for nearly all the flat-fish of the North Sea, the Danish coast for the haddock, and the slopes of the Great Fisher Bank for the cod. A spawning-ground, thus defined, is a reserve which assures the species of perpetuity. It is evident that were this reserve exhausted the future of the species would be endangered. But it cannot be said that the trawl catches large and small fish indifferently.

Certain English experts have made conclusive inquiries upon this point. They have refuted the argument that the meshes of the otter-trawl, large as they may be, close up under traction and prevent the immature fish from escaping. The experiments made were simple and convincing. "The pocket of a large regulation trawl with meshes of 6 inches (that is, of $1\frac{1}{2}$ inches wide from knot to knot) was surrounded by another net of a much finer mesh. The result, according to Mr. Wemyss Fulton, was as follows: 5,906 fish of 25 species were taken in the pocket of the trawl, while 32,237 escaped through the meshes and were found in the finer net. In other words, 19 per cent. were taken and 81 per cent. escaped." It is true, says Mr. Roy, that not all species of fish escape in the same proportions; for of 1,282 flounders which

entered the trawl only 5 escaped, while 77 per cent. of the haddock were captured ; but of whiting only 4 per cent. were retained, 96 per cent. escaping the large meshes. Other tests were made with pockets of different mesh (8 inches, or 2 inches square, and $10\frac{1}{2}$ inches, or $2\frac{5}{8}$ inches square). The one net allowed 93 per cent. of the fish caught to escape ; the other, 97 per cent. These experiments refer only to the pocket of the trawl ; the rest of the net being of a mesh 3 inches square allows all the smaller fish to pass without difficulty.

This inquiry, which was scientifically conducted, teaches us more than one lesson. The otter-trawl is evidently the direct cause of the diminution of the numbers of flounders and of flat-fish in general. However, it is less deadly to the haddock, and scarcely affects the round fish, and its effect in respect of herring is insignificant. It is therefore certain that it does contribute to the emptying of the North Sea, but in a very limited degree. If by chance its ravages were greater than this inquiry proves them to be, we should be forced to attribute them to the indirect action of the otter-trawl upon the fish ; that is, to the disturbance of the bottoms which constitute the nurseries or spawning-grounds. It must be remembered that such disturbances as these, whether natural or artificial, are destructive agencies. It is very probable that this is not simply a vain hypothesis, although there is no actual proof of its truth.

IV

So far we have considered only the large trawl or otter-trawl, which is employed in the Atlantic and on the northern fishing-grounds. I must now say something of the Mediterranean trawl, known as the ox-trawl or *grand gangui*. The ox-trawl is drawn by heavy boats known as

tartanes, which never work very far from the coast. All oceanographers are agreed in declaring that the ox-trawl is *par excellence* the worst engine of destruction. Not only has the number of fish captured by this means diminished during the last fifty years, but the size of the fish is constantly decreasing. Whiting, gurnards, turbot, and fishing-frogs, says M. Gounet, are no longer represented by large and mature specimens. Hunted and decimated on every hand, the adults are unable to evade the search of which they are the quarry, and so are denied the opportunity of full development. The young fish in turn find no shelter from the intensive exploitation of the fishing-grounds. The impoverishment of the former fishing-grounds has resulted in the retirement of all the "*tartanes*" of Marseilles.

The *gangui* fishery has not the importance of the ordinary trawling fishery ; it is counted among the small fisheries ; so here again we find the small fisherman guilty of wholesale destruction. I shall presently touch upon the devastation of which he is guilty when he works the inshore waters with a device far more pernicious than the curtain-net, the seine, or the eel-spear—the prawn-net or shrimp-trawl.

The prawn-net belongs to the category of small-meshed drag-nets.¹ It gathers, pell-mell, all that comes in its way, and as the bays, estuaries, and shallow bottoms are the favourite haunts both of prawns and of young fish,

¹ The prawn-net or shrimp-trawl (*chalut à chevrettes*) is a result of the French decree of May 10, 1862, of which more hereafter. This decree reduced the mesh of trawl-nets to '98 of an inch, whereas Articles 36 and 116 of the decree of July 4, 1853, had fixed the minimum at 1'38 inches. The prawn-fishers, who before 1862 had used the ordinary shrimp-net, hastened to adopt the trawl. Thenceforth the boats were equipped with two trawls : one for fish and one for prawns.

its destructive power is enormous. In 1863 M. Coste stated that in the neighbourhood of La Hougue the prawn-fishers destroyed, between April and September, in an area of barely 15 square miles, more than 200 millions of little soles, turbot, and brill. "Stretching over a length of ten leagues," says Coste, "is a vast asylum where the young generations of flat-fish take up their summer quarters. There they assemble and linger from April to September in such quantities that the prawn-fishers destroy them in alarming numbers: it is an absolute carnage. On the neighbouring shore there are a thousand persons engaged in the 'shrimping' industry. It may be asserted without exaggeration that no less than three millions of young turbot, soles, brill, plaice, &c., perish *at each tide*."

The destruction has been equally great at Croisic. Little immature soles have often been seen in the fish market. During the month of March, 1892, the men of Croisic were selling 900 pairs of soles for 48s., whereas if they had been left five months longer in the sea they would have fetched ten times the price. In 1884 M. Maraude, collaborating with the Commissary of Maritime Inscription for the district, instituted a committee of inquiry, which, after exploring a given area by means of the shrimp-net, came to the following conclusion:—

In obtaining one shilling's worth of shrimps the net destroys 43 pints of small fish, measuring about 340 to the pint. On June 28, 1895, the Dieppe Chambers of Commerce directed the following experiment: Equipped with the shrimp-trawl, the *Furet* made four draughts within sight of the shore and took, opposite Cayeux church, 229 fish, weighing altogether 17'64 lbs., unfit for sale; opposite Crotoy the catch consisted of 93 fish, of which only 14 flounders and lemon soles 6 to 8 inches in

length could possibly have been offered for sale. Between Ault and Mers 40 fish were taken, of which a dozen at most were fit for market; in the Neuville channel 18 fish were saleable out of 44. In the North Sea the capture of a pint of small shrimps entails the destruction of five to ten times the same amount of small fish, which die before they can be rejected. The Scottish shrimpers destroy more than half a million fry per diem. The whitebait fishers of Leigh, at the mouth of the Thames, are no whit less destructive than their French colleagues. Recently the naturalist Cunningham dragged a small shrimp-trawl 22 feet in width in the estuary of the Mersey for half an hour; he obtained, mingled with 56 pints of shrimps, 10,407 flounders, 375 lemon soles, 169 hake, 70 ling, and 12 soles; in short, a host of small and useless fish. "What chance," says M. Roché, "can we expect these species to have? Can we seriously suppose that fish which have been pressed to the bottom of a bag which is almost hermetically sealed, and have been dragged for several hours, at a considerable speed, over the bottom of the sea, will be alive, or likely to recover their pristine vitality, when thrown back into the sea? The shrimp-catchers themselves have no illusions on the subject, neither have the curtain or drag-net fishers at the mouths of rivers, concerning the enormous destruction caused by their method of fishing. They sell all this 'spat' for manure. These are interesting facts, especially when we remember that a whole series of laws exists to protect our coastal spawning-beds. At the present moment (since 1892 matters have only grown worse) the shrimps also are growing fewer and fewer in the localities where the 'shrimp-trawl' has overturned the seaweed and the hatching-grounds and nurseries. It seems to me that we ought

to ensure that nothing is used but the basket-trap, as it is used on the Breton coast (even in the interests of the shrimp and prawn fishery itself) and that a serious examination should be made of the damage done by the use of curtain and stake and drag nets at the mouths of rivers ; damage so abominable that whole waggon-loads of the young fish killed by these devices are carried away to fatten the land."

Here I end the tale of the ravages from which the dweller on the coast suffers, yet which he has deliberately created. The chief sinner is not the fisherman on a large scale, but the small fisherman, the inshore fisher ; who devastates the breeding and spawning grounds, uproots the seaweed, kills the invertebrates, the habitual food of the fish, *kills the fry and the young fish*, and makes a desert everywhere.

The medal has two faces : we have examined that on which the ravages of man are recorded. Now let us turn it over, to read the inscription of the necessary reparation.

CHAPTER V

FISHERY LAWS

- I. The territorial waters of the Hague Convention (1883)—The fisheries police in France and the decrees of 1853 and 1862.
- II. A curious attempt at protecting the nurseries in neutral waters; the English Parliament and the Moray Firth.
- III. Essential measures: universal interdiction along the coast of all destructive devices, and universal protection of territorial waters.

It is easier to make social laws than to discover natural laws. Legislation has therefore commenced by acting on the inspiration of two obvious principles: by forbidding what is injurious to the common good and recommending what is profitable.

I

But the ocean is free to all—*usus maris publicus, et proprietas nullius*, as Justinian wrote of old. Yet it has been found necessary to delimit a belt along the coasts within which the penal sanctions might be applied. The limit of this belt is known as the territorial limit, or the continental limit. The territorial waters of the English coast are exclusively English, and are subject to English jurisdiction; the French territorial waters are subject to French jurisdiction. They extend from low-water-mark to a line 3 nautical miles from shore, or a nautical

league, or 6,077 yards. All the European Powers—Great Britain, France, Germany, Belgium, Holland, Denmark, Sweden—adhering to the Convention of the Hague (1883) accept this limit, saving that Norway and Sweden have retained 4 miles as the distance of the limit from low-water. “In the case of bays,” says Clause II. of the Convention, “the radius of 3 miles shall be measured from a straight line drawn across the bay as near as possible to the entrance, at the first point where the width does not exceed 10 miles.” The abundance and almost constant presence of fishermen of different nationalities in the North Sea—of some 120,000 men each year—has resulted in legislation which affects its whole area. The Hague Convention took all useful precautions that property in lost or entangled nets should be respected; it organised a system of numbering and marking all vessels, and created an international service of protection and inspection by means of the warships of the signatory Powers. In France this service is confided to the naval station of the Channel and the North Sea. It is undertaken by a despatch-boat, the *Ibis*, and two sometime trawlers, the *Estafette* and the *Sentinelle*, for the North Sea, and a torpedo-boat, the *Mangini*, for the Channel.

These legislative measures are in principle designed to sum up the previous regulations and serve as a starting-point for new. As long ago as the reign of Henri III. an edict forbade the use of drag-nets or trawls along the coast. Under Louis XIV. in 1681 and the Republic in 1790 this prohibition was repeated. From 1818 to 1830 trawling was forbidden in the roadstead of Toulon. Finally the decree of 1862, which was apparently a mitigated version of the decree of 1853, *prohibited* generally and absolutely *the use of the trawl*

*in territorial waters.*¹ The vessels told off to guard the fisheries are entrusted with the supervision of the vessels of all nationalities. It is to be regretted that they are not as severe upon foreigners as the latter have been to the French. The decree of May 10, 1862, also determined the size of the meshes of the nets to be used, on the following lines:—Large trawl, a mesh 1·1 inch wide (on the side); small trawl, mesh of the net, 1 inch (to be exact, ·98 of an inch); mesh of the pocket, 1·18 inches; line, ·39 of an inch in circumference. It prohibited the capture, salting, purchase, sale, transport, or use for any purpose whatever of fish below the adult stage; that is to say, less than 10 centimetres (3·937 inches) in length, measured from the eye to the root of the tail.

The service of the fisheries police was instituted by the decree of July 4, 1853, and reorganised by the decree of June 16, 1908. The service is commanded by the maritime prefects, whose authority devolves upon the general commissaries and *chefs de service*. Under the orders of these superior administrators the

¹ A curious protest was presented by the fishers of Trouville and Villerville to the Congress of Maritime Fisheries at Dieppe (1908). "The deep-sea fishers of the neighbourhood of Trouville, considering that the dragging of the trawl over the banks, liable to maintain the reproduction of the sedentary species, is indispensable to the clearing of these banks, in other words to their culture; that trawling has the effect of causing to rise from the bottom the nourishment which is proper to nearly all the species frequenting our territorial waters, and even to herrings, sardines, &c. . . .; that the laws now in force are too Draconian in respect of fishermen caught using the large trawl-net within the three-mile limit . . . in the sense that it deprives them, by the confiscation of all their fishing gear, of their instruments of labour . . . express the desire that the decree of May 10, 1862, shall be modified in the direction indicated."

commissaries of the Maritime Inscription are specially instructed to ensure the execution of the laws and regulations affecting the coastwise fisheries. The commissaries of the Maritime Inscription are seconded by officers and officer-mariners (*officiers-mariniers*) commanding the boats and crews of the fish-guard (*garde-pêche*), the inspectors of maritime fisheries, the syndics of seamen (*syndics des gens de mer*), the master-fishermen (*prud'hommes pêcheurs*), the master maritime fish-guards (*patrons garde-pêche maritimes*), the maritime fish-guards (*garde-pêche maritimes*), and the *gendarmes de la marine*. In the matter of the sale, transport, or hawking of fry, immature fish, or shell-fish under the prescribed dimensions, the functions of the police are exercised concurrently by the officers and agents already named, by the sworn municipal agents, and the officials of the indirect taxation and *octroi* departments. What a waste of paper and ink all this must represent!

It is obvious that the decree of 1862 includes the fundamental and necessary prohibitions, for the coast and its nurseries must at all costs be protected: but history has shown this document to be insufficient. Does its inefficacy arise from its very nature, or is it the result of a lack of supervision? I incline strongly to the second hypothesis. There is no lack of facts to establish it, and those who, like the writer of these lines, have a thorough knowledge of the affairs of a great port are well aware of this. In deference to one of the resolutions of the Congress of Maritime Fisheries of Les Sables-d'Olonne, the Minister of the Marine, in his circular of January 20, 1897, instructed his officers, officials, and agents to enforce the strict observation of the regulations relating to the meshes

of drag-nets, the minimum size of saleable fish, and the distance from the shore to be observed by the off-shore trawlers. The South of France became greatly excited ; there was a strong feeling everywhere ; and many of the courts were charitable enough to acquit the offenders. The system of supervision is at fault, being badly organised, despite the majestic machinery instituted by the decrees. Among the subordinate agents—that is, among those who are in close and constant contact with the fishermen—are some who are appointed by the suffrages of their comrades. I am afraid their authority is insufficient. In 1898 the Chamber of Commerce of Boulogne demanded the creation of a local police, like that of Martigues, Cette, Porte-Vendres, Arcachon, and Douarnenez, equipped with boats manned by armed naval crews. It also demanded that the nautical guards (*gardes maritimes*), then scattered along the coast, should be grouped in the smaller administrative centres (*chefs-lieux de quartier*).

It is always the case that as the complaints of the fishermen respecting the scarcity of fish become more numerous and more vehement, so the regulations are more numerous and more stringent. To take an example : the sailing trawl (*gangui à la voile*) of the Mediterranean is an extremely destructive device, constructed on the model of the ox-trawl (*filet bœuf*). The decree of 1862 had authorised it, so long as the meshes were at least 1 inch in diameter. The measure was apparently conciliatory ; but protests were made. Drag-nets, however, had energetic champions, and the administration temporised. Of this we may judge by the following extracts from the decree of October 9, 1890:—

"ART. 4.—From the 1st of April to the 30th of September of each year the sailing trawlers (*pêcheurs au gangui à la voile*) of the quarter of Marseilles may sail at any hour ; but they are expressly forbidden to dip their nets before eight o'clock in the morning ; and they must haul them at five o'clock in the afternoon.

"ART. 5.—During this period they may drag their nets along the Marseilles coast in depths of 8 fathoms and over, working seawards, except in the localities hereafter indicated, where they must not trawl in less than 16 fathoms . . . (then follows the enumeration of the localities in question).

"ART. 6.—From the 1st of October to the 30th of March the sailing trawlers may ply their calling day and night along the whole of the coast of the quarter of Marseilles, taking care to work seawards from depths of 8 fathoms."

II

Thus prohibitions are enacted which do not prohibit. We must not be surprised by this ; for what is agreeable to one party is often disagreeable to another : and if we had forgotten that fact, England and Scotland would remind us of it. The great Moray Firth, which lies to the north of Scotland between Duncansby Head and Fraserburg, is rightly considered one of the chief nurseries of the North Sea.¹ Although it belongs to the open and common sea, as defined by the Hague Convention, the Fishery Board of Scotland wished to protect it. In 1889 it forbade, under penalty of a fine of £100, all Scottish and English boats *only* to use the

¹ Depth : on the northern slope from 55 to 80 fathoms ; almost everywhere else from 11 to 27 fathoms. Sand, muddy sand, gravel, and rocks.

trawl in the Firth, or to sell the fish caught there in Scottish ports. England, seeing herself placed at a disadvantage, and to the profit of foreigners, protested. The question, said M. Roy, remained at a standstill for years; the law was ill applied and infringed without much trouble by the Grimsby trawlers, who often preferred to pay the fine and fish notwithstanding.

For the rest, there was another means of evading the difficulty which was still more compromising: namely, for the English trawlers to fly the Norwegian flag, as the Norwegian law of armaments permits a vessel to hoist the Norwegian flag providing there be a Norwegian on board the vessel. This ingenious procedure was applied upon an enormous scale, and the "Grimsby Norwegian" came into being—all on board of her English "except the cook and the flag." In 1905 the North Sea Fishery Protection Association sent up to Parliament a projected Bill, which would have applied the Scottish law to foreigners. The Bill was not debated. In 1908 Mr. Sinclair, M.P., moved that the fish of the Moray Firth should not be sold in any port of the United Kingdom. Nothing definite has as yet occurred; but the projected Bill has excited the most lively discussion, and has even been dubbed the "Bill for starving England." The history of this Parliamentary episode is interesting, being unique; it is the first attempt in the direction of protecting the piscine nursery in free waters or the fish of the North Sea; it is the first limit which has been imposed upon the liberty of the capture and sale of fish. I have said the first attempt, the first limit; for in my opinion the protectionist tendencies which are daily undergoing further development in the continental waters will finally prevail over certain areas of the sea. But the Scotch problem will not be solved unless one of two

alternatives can be realised. Either the nations interested must conclude an agreement on the basis of the Hague Convention or the Convention will be abandoned. In any case it is to be hoped that the bottoms of bays and estuaries will be *entirely* protected ; if not all the year, at least while the larvæ and fry are growing. I do not speak of the spawning-grounds in the open sea, as they are beyond the reach of the small fisherman ; moreover, their delimitation is difficult and their supervision impossible.

III

While awaiting the new era, it is, I repeat, indispensable that France should protect her territorial waters against the delinquencies of the small fisherman.¹ The 'long-shore nurseries and spawning-grounds must be absolutely respected ; seines, curtain-nets, and shrimp-nets must disappear for ever from our bays and estuaries ; the ox-trawl must be kept at sea ; and severe penalties, rigorously applied, must bring the delinquents to their senses, to whatever social class they may belong. This must be done in the interest of the public as well as of the fishers themselves.² It may be objected : " But there are 60,000

¹ All the European nations have protected their territorial waters : Italy (the law of 1877 prohibiting the sale of young fish), Denmark (the law of April 5, 1888, having the same end), Holland (the 3,000 fishers of the Zuyder Zee being obliged, by the law of 1889, to abstain from fishing at frequent and stated intervals), England (the Hull Congress of 1890, prohibiting the capture and sale of young fish, and of turbot of less than 10 inches in length), Belgium (the law of August 29, 1891, and the Royal Decree of September 5, 1892).

² Some of the small fishers have been alarmed at the damage they have done (at Panne, in 1888, and at Blankenberghe). Others (at Croisic) have substituted the basket-trap for the shrimp-trawl. The basket-trap or *casier* is made somewhat like an eel-pot, some 30 inches long, and is covered with a net with a mesh of about $\frac{1}{4}$ of an inch. Twenty-five *casiers* yield as many shrimps as a small trawl.

people in France who live by the petty coast fisheries : what is to become of them ?" The reply is simple. It is enough to point out that these people are preparing, with no profit to any one, a future of poverty for themselves, and that sooner or later they will have to find other occupations. Is it not more reasonable that they should look to the sea-fisheries, to the merchant marine, and to agriculture for the bread which they will very soon lack ? Then, moreover, they will not all be affected ; for if the number of petty fishers diminishes the number of fish taken by each will increase. And there are certain species of fish which are regarded as a luxury, such as the sole and the turbot, which people prefer to eat absolutely fresh, almost as they come from the water, so that these will always be best sought for near the shore.

Moreover, the prohibition of destructive gear should be supplemented by a close inspection of the fish taken to the markets. The decree of 1862 (Art. 3, § 11) enacts as much ; but the method of measurement thereby indicated is rather awkward. Instead of measuring the length of the fish from the eye to the root of the tail, it is quicker to measure from the tip of the mouth to the end of the tail fin. M. Gourret, who favours this method, has published a very complete list of minimum sizes : that is, of the sizes of each species at the moment when its sexual organs are sufficiently developed to permit of reproduction. The pellucid aphyra or *nonnat* (the *Aphyes pellucida* or small goby—one of the constituents of *poutina*) is adult when it attains a length of 1 inch ; the atherine is adult at $2\frac{1}{2}$ inches ; the wrass at $2\frac{3}{4}$ inches ; the flounder at $3\frac{1}{8}$; the anchovy at 4 ; the red mullet and sardine at $4\frac{2}{3}$; the sole at $5\frac{1}{10}$; the caplin, brill and turbot at $5\frac{1}{2}$; the grey mullet and the shad at $6\frac{2}{10}$; the

hake and whiting at $6\frac{3}{4}$; the red gurnard at $7\frac{9}{10}$; the mackerel at 9, and the angler-fish at 12. The municipal employees at the fish markets would very quickly acquire the habit of estimating the prescribed dimensions at a glance.

To return : the fry and the young of all edible species should be protected. There are several means of ensuring their protection. I have mentioned three : the prohibition of destructive gear in territorial waters, involving the complete disappearance of the shrimp-trawl ; the protection of spawning-grounds and nurseries, that is, the bottoms of bays and estuaries, at the season of spawning—say from May to June ; and the prohibition of the sale of all fish below a certain minimum size. The first means is the most important. On this depend the other two, and it could be substituted for both.

There is nothing here that was not provided for in the decree of 1862 ; but it must be applied in its integrity. If the administration were also to order a methodical pursuit of voracious fish and mammals,¹ and then a series of measures guarding against amateur fishermen and regulating the matter of outfalls and refuse, it would hold a weapon which, if properly handled, would be really efficacious. The other regulations are of the industrial order ; they are based upon the experience of centuries, and are ratified by modern science.

¹ The guard-ship of Douarnenez destroys a certain number of belugas every year.

CHAPTER VI

REPOPULATION OF FISHING-GROUNDS

- I. Reservations or *cantonnements*—Their utility. II. The movements of the "ground" species and the "marked fish" of St. Andrews Bay—Transplantations of plaice on the Dogger Bank. III. The plaice of Lümfjord—The *valli* of Comacchio, the *valli* of Venetia, and the salt-water pools and lagoons of the French coast. IV. The fishponds of Arcachon and the "fish marshes" of Vendée—Their history, description, and use—The fishponds of the Atlantic coast and the shores of Languedoc. V. Conclusion.

THE idea of controlling the colossal shoals of herrings or sardines is laughable. But the fish that feed on the floor of the sea, whose habits are sedentary, invite a prudential treatment. Once the fry and the young fish are safely sheltered it is easy to extend the principle of protection to certain adult individuals, and thus to institute them guardians of the race.

I

For this purpose choose a locality which is both a spawning-ground and a place where such fish as live on the bottom naturally congregate; delimit this area and make its position precisely known, then decree that all fishing shall be prohibited within its limits, and you will have a preserve wherein fish will multiply and grow, a "stock" of utilisable animal material, or, to use

the word employed in France, a *cantonnement*. The utility of such reservations is proved by experience. Here is M. Gounet's report: "Prohibited between 1793 and 1830 in the *quartier* of Marseilles, the *grand gangui* was freely used after 1830, by *tartanes* of 10 or 12 tons displacement, on the muddy bottoms some distance off shore from Grand-Vallet (near Cap Couronne) to Planier, and also to the west. The draughts used then to be almost miraculous, and our old fishermen can remember the time when 150 hundredweight of fish used to be taken at each *baou*—that is, each time the ox-trawl was hauled. This abundance of fish—very natural, if we remember the prohibition which had lasted for thirty-seven years—and which demonstrates the excellence of the principle of the reservations recommended to-day—had as its first result the equipment of Marseilles with a new fleet of *tartanes*, a fleet which in a few years' time was sixty strong, plying between Planier, Couronne, and the mouths of the Rhone. Dories weighing from 4 to 7 lbs. and fat hake of 15 and 18 lbs. were sold singly in the roads for next to nothing, for a few halfpence." After the Bay of Marseilles, the Bay of Toulon had its turn. In 1875, on the initiative of the *patron* Garnier, the trawl was prohibited from April to June. This three months' truce resulted in renewing the stock of fish, and up till the end of the year the boats returned to the quays loaded with red mullet. In 1888 the Administration created vast reservations in the Aber-Wrach, near Brest; their success was complete.¹ There is no need to multiply instances. It is henceforth proved that reservations are a necessity. The "Consultation Committee of Sea Fisheries," in 1899, expressed the desire that the

¹ The reservations of Termini-Imerese, in Sicily, gave equally good results.

Department of the Marine, using the powers conferred upon it by the law of January 5, 1852, should make the creation of reserves general ; it even went so far as to state that if the reserves were absolutely respected the trawl might be authorised in free territorial waters. In 1901 it advised the maintenance and at need the establishment of new reserves in the coastal regions where the fishers are numerous but not congested. It appeared a difficult matter to force the acceptance of this system where the populations are dense and concentrated in a few ports ; what is good for the Mediterranean may not be good for the Channel.

In explaining the theory of reserves I have hinted at the two methods of reservation. Should they be temporary or permanent ? It is obvious that the ideal reservation, regarded as a stock of animal material, is by definition an inviolable asylum where life is assured to the reproductive adults as well as to the young ; a gigantic mixed nursery, an effective centre of production whence the surplusage of individuals, driven by competition, would radiate in all directions. But the exigencies of theory often accord but ill with corporate interests, and the multiplication of coastal reserves would quickly arouse the anger of the fishermen. On the other hand, it is chiefly at the moment of spawning that fish assemble in compact phalanxes, in fixed localities, and it has not been proved, as we shall directly see, that those fish which feed on the bottom remain always in the same locality. We must therefore fall back upon the temporary reservation. A temporary reservation is a spawning-ground and nursery, precisely located by landmarks, on which fishing is prohibited solely while the adults are spawning and the fry growing up, or from the middle of March to the end of June. These dates are by

no means of absolute value ; they change according to locality ; nevertheless they denote a fairly universal period of spawning and development. In short, the temporary reservation is on the whole sufficient ; but it would be useless if, instead of re-establishing it annually in the same place, we were to shift it along the coast. Let us have plenty of reserves—permanent when the thing is possible, and in all other cases temporary.

II

The question of which I have just treated from an empirical point of view is connected with that of the movement of those fishes which live on the bottom ; a question of which the solution has been sought by scientific methods. I refer to the experiments undertaken in the North Sea by means of marked fishes. A batch of fish is captured at a given spot ; the experimenters satisfy themselves that the individual specimens have suffered no lesion and are well and lively ; they attach to the back of each a little oblong label having a number, or perforate one particular fin with a punch of determined shape ; finally all the fish are returned to the sea at *the same spot*. The fishermen of the neighbouring ports are invited, in return for a small reward, to advise the Committee of Inquiry whenever they capture any of these fish in their nets. It is thus a simple matter to estimate the distance travelled by the latter in a given number of days. The best known of these experiments was carried out in St. Andrew's Bay, in Scotland. Of 1,250 plaice, 103 were retaken, which in 239 days had travelled a distance of 6 miles. Of 337 dabs released, 11 were retaken ; the average time was 178 days, the average distance 37 miles. Of 196 cod, 10 were retaken ; average time, 74 days ; average distance, 52

miles. Of 71 rays, 2 were retaken ; of 4 turbot and 273 soles only one of each species. If we establish the ratio of marked fish to fish recaptured, we obtain the following series : turbot, plaice, cod, common dab, ray, sole ; a series in which the species are arranged according to the extent of their travels. In other words, the turbot and plaice are more sedentary than the sole. Between 1901 and 1903 a large number of plaice were marked and released in English and Scottish waters. At the end of 60 days more than 10 per cent. were retaken, at an average distance of 150 miles from the point of release. As a rule plaice do not leave the North Sea. There is a record of one, however, which was released on the Lemon Bank near Cromer in December, 1903, to be retaken in April, 1904, at a distance of 200 miles—in the open Channel, off Winchelsea. Later experiments have resulted in the recapture of as much as and more than 20 per 100 of the marked specimens. It is doubtless too soon to draw definite conclusions from experiments of this sort, which are difficult and costly ; however, they bring before us three important truths : (1) The species that live upon the sea-bottom do not remain absolutely in one place, as though glued to the sand. (2) Their movements are neither very rapid nor very extensive. (3) On the whole, they remain within a comparatively restricted area.

These are not empty scientific experiments. Not only do they give us information as to the habits of fish ; they render possible a valuable kind of industrial operation. If the marked fish, young or adult, are rejected *not at the place of their capture*, but elsewhere, in a propitious locality suitably chosen—if, in a word, they are “transplanted”—we can “plant” such a fishing-ground as we please, just as a field is sown.

Let us once more consider the North Sea. The plaice of the Dogger Bank are scarce and of large dimensions. Six years ago Mr. Walter Garstang, the delegate of the British Government to the International Commission of Inquiry into the Northern Seas, conceived the idea of transplanting upon the Dogger marked plaice caught near the shore. He made three trips upon a "live carrier"; on April 13, 1904, 441 small plaice caught in Bridlington Bay were thrown into the sea on the eastern slopes of the Dogger: in the course of May 450 from the Dutch coast were transported to the centre of the Bank; and on the 25th-26th May 706 from Danish waters were returned to the sea—362 on the southern tail of the Bank and 344 on the eastern slopes. As soon as they were transplanted the plaice began to spread all over the Bank. None were recovered during the summer; in the autumn many returned; then they left the Dogger, for one was taken in November in the open sea off Denmark, another in December between the Orkneys and the Shetlands, and a third in January near Lowestoft. "Altogether," says M. Cligny, "in the space of ten months 95 plaice were recaptured—namely, 14 per cent. of the Bridlington plaice and 7 per cent. of the Jutland plaice. The plaice taken from the Danish coast and transplanted to the Dogger seem to have grown normally, despite the length of transport. But the Bridlington plaice, returned to the water in excellent condition, underwent an absolutely unexpected growth; specimens which measured 7·8 inches in length at the beginning of the experiment had gained on an average 4·75 to 5 inches in seven months, while the growth of such fish inshore does not appear to exceed 2 or 3 inches a year. Expressed in terms of weight, the increase is naturally still more significant; for plaice weighing between 3 and 4 ounces when

released weighed 14 to 16 and 17 ounces, or an increase of 330 to 360 per cent." Supposing that a similar experiment were carried out with like success with 1,000,000 individuals, Mr. Garstang arrives at the following conclusions: "Supposing the transplantation were made in April and May, the following figures would hold good: the spring fisheries would at once destroy a fourth of the contingent without any profit; from June to September 90,000 plaice would be taken (12 per cent.), weighing 130 cwt., at 26s. per cwt., the total value being £172; between October and February 105,600 plaice would be taken (16 per cent.), weighing 20 tons, at 51s. 3d. per cwt., or of a total value of £992. Thus the operation would give a gross profit of £1,164—a sum very greatly in excess of the cost of the experiment—and would leave in the North Sea 554,000 plaice, which would then be worth at least £4,800. Supposing the transplantation were effected in June, after the spring catches, the waste of these latter would be avoided; the operation would then yield a gross profit of some £1,360, leaving in the North Sea 740,000 plaice, which would be worth at least £6,000."

I need not remark that the quantity of fish capable of being transplanted upon any particular ground would be limited by the conditions of the struggle for life. This is a problem for the oceanographers; but it is already obvious that those desiring to transplant any species should go to the *overstocked* nursery grounds, where the struggle for existence is most intense. The operation of transplantation will then be equally beneficial to the nursery and to the ground to which the fish are transported; to which the superfluity of life which was formerly a factor of destruction will bring fertility and wealth. The fisherman will lose nothing. It is sometimes necessary to protect fish against themselves.

III

This new piscatorial technique is as yet in the state of a laboratory experiment ; but so far it has shown itself extremely effectual and perfectly practicable. Do not let us forget that it is in the open sea that it has succeeded. It will be all the more valuable in the enclosed salt-water lakes, lagoons, or pools of the coast.

To the north of Jutland stretches a network of salt lakes and channels, all connected, and all debouching to the west in the North Sea and to the east in the Baltic. They include an inland sea of more than 600 square miles in area ; shallow, sandy, and rich in alimentary matter. This inland sea is known as the Lüm fjord. The Lüm fjord is a "nursery" of small plaice ; perhaps the most fruitful there is after that of Heligoland. The fish *are not hatched there* ; they come from the North Sea during their very first youth, and there grow up, but in a very unequal fashion. Certain lakes are swarming with little plaice which remain practically dwarfs. In certain others the plaice are scarcer, but grow quickly ; here the struggle for life is barely perceptible, there it is severe in the extreme. Let us remember here that the prosperity of the individuals *of one single species* is in an inverse ratio to the severity of the fight for survival. A species being in effect a harmonious whole, the factors of survival in a region when nourishment is limited tend to level it to a normal type. Consequently, the more numerous the individuals of any given species concentrated at any one point, the more will they hamper one another, and the more debilitating will be the action of competition, which, instead of resulting in a number of robust individuals, or the sacrifice of a large number of victims, will produce only indifferent specimens.

In 1892 MM. Mikkelsen and Mahlsen transported a batch of *small* plaice, in good condition, to one of the lakes full of *large* plaice. The small plaice promptly proceeded to grow. The two naturalists effected a number of transplantations, and even sought a further supply of little fish. The success of their experiment was complete. To-day the copious fisheries of Lüm fjord are the result of these transplantations. This is not a gratuitous statement—the scientific proof dates from 1895. At that time 82,500 young plaice, of which 10,900 were marked, were placed in Thisted Bredning, a lake situated on the eastern portion of the fjord, which was frequented by large plaice. Since then a proportion of marked fish has been retaken at least equal to the original proportions. Since 1892 operations have continued without a break, thanks to the local societies and with the pecuniary help of the Danish society. The small sailing vessels trawling near the coast capture at least 50,000 young plaice apiece in a single day. The best of these are selected and transported, by means of tank-carriers, to the Lüm fjord. In 1900 200,000 such fish were turned in. In May, 1905, the societies of Nykiobing and Thisted transplanted 80,000. The expenses are modest : each fish transported costs about $\cdot 3$ or $\cdot 4$ of a penny; at the end of the year it is worth 1·8d., and by the spring 4·5d. There is one more step to be taken. The young plaice of the eastern lakes of the Lüm fjord return to the Baltic when they have grown. By retaining them by means of dams and weirs the Danish fishers would increase their stock of young fish and ensure a still greater production.

Weirs, moreover, would be no new device. It is probable that the Venetians erected dams in their lagoons between 1152 and 1181; at all events, there existed at least

61 about the year 1535.¹ Between February and April many fish still in the fry stage of development come up from the open sea towards the lagoons. They remain there for some time ; then from various causes they make ready to leave, principally because of the diminishing temperature and the necessity of spawning. But at this moment the sluices of the dams are shut, and the fish remain prisoners. The weirs were at first made of bundles of reeds, then of banks of beaten earth ; now proper dams are constructed, and "to drive the shoals of fish in a given direction," writes Dr. Schmarda, "or into a given canal, the water is removed by opening sluices made for that purpose, as the fish always swim against the current." Another condition, equally indispensable, is the presence of brackish water in the lagoons, due to the presence of a river, stream, or canal, the odour of fresh water attracting the fry.

One of the most celebrated of these lagoons is that of Comacchio, situated between the mouths of the Po to the north and the city of Ravenna to the south. It is closed by a dike which has four openings communicating with the sea. It is divided into 15 artificial basins, each communicating on one hand with the fresh water brought from two branches of the delta of the Po, the Volano and the Reno, and on the other hand with the salt water. There are 20 sluices and 80 canals. By means of these arrangements two opposite currents can be induced—a current running from the lagoon into the sea, which

¹ The Adriatic is traversed by a current which commences in the Archipelago, follows the coast of Greece and the whole eastern shore, makes the circuit of the Gulf of Venice, and descends along the Italian coast. Its speed amounts to rather less than a third of a mile an hour. The density of Adriatic water is 1·0291 and the salinity 29·122. The average height of spring tides is 23·8 inches.

causes the entrance of the fish in the spring, and a current running from the sea into the lagoon, which brings out the fish in the autumn. But although the gates are open in the spring to receive, they are closed in the autumn to retain. The fish cannot reach them, for upon their way through each basin they encounter nets, fashioned in compartments, numerous, and provided with basket-traps, in which they remain captive. There are five species caught in these basins—bass, grey mullet, gobies, atherine, and eels.¹ According to MM. Schmarda and Gobin, a kilogramme (2·2 lbs.) of eel fry, consisting of 3,600 young eels, will in three years acquire a weight of 6,000 kilogrammes (nearly 6 tons) and a value of £120 to £140. A kilogramme-weight of mullet will include 20,000 young fry. At the end of a year half will be dead, but each will weigh a third of a pound. The annual yield of the lagoon varies from 48 to 55·6 lbs. per hectare—about 19 to 22 lbs. per acre.

The Italians give the name of *valle* to any lagoon devoted to the breeding of fish. In Venetia, according to Mr. Thorndike-Nourse, there are more than 175 *valli*. They are remarkable by the complexity of their channels, which turn like the paths of a maze and are known as *cogolere*; by the presence of a canal, or *circondaria*, which, surrounding the lagoon, serves as a refuge to the fish during the great heats and provokes a perceptible movement of the waters which is propitious to aeration; and, finally, by the deep moats and ditches which serve

¹ The tolerance of fish for sea-salt is remarkable. Taking the litre as the unit of measure—or 1,000 parts—here is a list of the quantities of salt which the principal species living in the lagoons or fish-ponds are capable of supporting: Eels, 0 to 40; bar, 10 to 40; mullet, 16 to 40; plaice, 20 to 40; sole, 25 to 40; golden mullet, 24 to 35; blind mullet, 5 to 40.

as winter stations. It is essential to protect the fish against the north winds. A very pretty system is employed. When the *bora* blows fresh water is let into the winter moats. On account of its lesser density this water remains on the surface, where it quickly freezes, and this layer of ice is the best shelter the fish could have.

Lagoons, seashore ponds, closed bays, and fjords thus dealt with are by no means uncommon in Europe. I remember visiting the important dams in the Uddevalla Fjord in the north of Göteborg. The Norwegians make use of the creeks and coves into which the brooks empty in order to breed trout and American salmon or brook trout, and even carp. The growth of these three species is very rapid, on account of the greater abundance of nourishment in salt water than in fresh. This truth is general, but by no means absolute. Thus since 1863 the Vendéan landowners have followed the custom of peopling their moats, ditches, lakes, and small ponds with the fry of carp, bar, common dabs, plaice, mullet, &c.¹ All these fry grow more rapidly than in the sea, but do not breed. Their exile inland is therefore profitable to them. In France the Princess Bacciochi, in 1865 or thereabouts, built a dike pierced with two sluices in a creek of the river d'Auray, but since 1883 the basin has been converted into an oyster-park. At the mouth of the Etel the numerous small lagoons have been provided with two sets of sluices; bar and mullet thrive there. The pools on the oceanic coast are not suitable

¹ At Vieux-Boucau the little lake of La Pensolle, which only communicates with the sea when the tide is extremely high, is supplied with "*pibales*"—so in the Landes are called the young eels from $2\frac{3}{4}$ to 4 inches long—by a fisherman, who puts in some 45 to 70 lbs. of *pibales* each year and recovers them later on in the shape of fine adult eels (P. Arné). About the year 60 B.C. Sergius Orata introduced the gilt-head into Lake Locrina, near Naples.

for breeding or nursery purposes. Neither are the pools of Thau and Berre on the Mediterranean side very suitable, as their whole area is part of the public domain, so that breeding-grounds could only be established in the unsheltered centre portions, which are exposed to the full force of the gale.¹ The pool of Valcarès in Camargue, however, might well become a French analogy of Comacchio. In 1866 M. Léon Vidal and in 1880 Dr. Brocchi proposed the formation of two drains with sluices, one on the Grand-Rhône near Beaujeu and one on the Petit-Rhône by Château d'Avignon, thus creating a current of fresh water through the pool. Nothing came of this proposal. Along the French coasts there are many places where dams might be built, as the roadstead of Pénérf in the Gulf of Morbihan, the creek at Fouras, the "flats" of Loix and Ars on the Ile de Ré, the bay of Aiguillon, the creeks of Tréberon and Lanveoc in the Brest roadstead, the bay of Carentec, and the bay of Morlaix. But we will not give way to illusions; the French are a studious race and are satisfied with projects.

IV

Looking back over the ground already covered, the reader will see that hitherto I have spoken only of the utilisation of natural sheets of water for the purpose of breeding or rearing fish—of the suitable equipment and management of a bay, lagoon, or creek. But we are not confined to such operations as these; where there are no

¹ Recently the Chamber of Deputies voted a proposition introduced by MM. Sarraut, Aldy, and Astier to the effect that the State should buy all salt-water lakes and lagoons, fishponds, tunny-fisheries, and other fishery establishments, in order to assist the fishermen in the exercise of their calling. The Senate rejected the proposition.

salt-water lakes or lagoons they have been made. I refer to artificial fishponds and reservoirs. The two terms are often confounded. It would seem of advantage to apply the term "fishpond" (*vivier*) to any artificial basin of regular form which the fish enter in the shape of fry and where they grow and are finally captured, while the term "reservoir" should be applied to the temporary quarters of adult fish.

The history of the fishponds of Arcachon is extremely instructive. The Captaux de Buch, in the Middle Ages, owned the salt-marshes forming the shores of the Arcachon basin. Men of battle and of conquest for the most part, and also largely favoured by the Court, they professed an utter disdain for a locality where the soil was so poverty-stricken. But the weakness of the government of Louis XV., the scandals of the Pact of Famine, which, by "cornering" grain, devastated whole provinces, the overwhelming taxes of the Abbé Terray, the diminution of private revenues, and, finally, bankruptcy, caused a general wave of poverty. The Lords of Buch suffered with the rest. They then thought of turning their marshes to some account, and on December 7, 1771, one of them, namely, François de Durfort, Marquis de Civrac, ceded "under the title of inconvertible property, upon long feudal lease, to Messire Guesnon de Bonneuil, the quantity of land required to make 145 livres"—meaning a portion of land bringing in a livre of rent—"of salt-marshes (*marais salants*), to be taken in the quarter called de Lauton, situate on the land and in the lordship of Certes." I extract this sentence from the excellent *Mémoire sur Arcachon* by MM. Descas and Muratet. By 1778 all the swamps of Certes were leased as salt-marshes. However, the undertaking failed on account of the indifferent profits and the suppression of

the concession of the rights to prepare salt. Eleven years later—on August 3, 1789—the proprietor and the tenant of the salt-marshes of Certes “were compelled,” according to the terms of the contract made between them, “to put these lands to a totally different use.” Thus were the salt-marshes transformed into fishponds. The authors of this innovation perhaps recollected that on March 29, 1772, a merchant, by name Turpin, had demanded of the intendant of Guyenne the authorisation to establish a fishpond on the Ile aux Oiseaux, right in the middle of the Bay of Arcachon, and that in Vendée there were “fish-marshes.” These fish-marshes, which are still in use to-day, are, I believe, the first ever established in France. About the year 1140 the Abbé de Talmont described them, and spoke of them as being old salt-marshes. It is possible that some of them had been from the outset especially devoted to the rearing of fish, but it is certain that at that remote period the poverty of the district was extreme. Even now the marshes are divided into very small holdings. I shall be excused for having furnished so many details if the reader will perceive in my presentment of the matter a fresh example of the influence of economic factors upon the social life.

At the present time the fishponds of Arcachon, which lie on either side of the estuary of the Leyre, cover nearly 3,200 acres, or five square miles. The largest are those of M. C. Descas at Audenge (1,150 acres) and those of Mme. de Lespinasse at Teich (330 acres). All are constructed on the same model. The dikes, which slope gently towards the seaward side, are seven to nine yards wide at the base and rise about 40 inches above the highest high-tide mark. They are made of beaten earth covered with grasses and planted with wooden stakes connected by wires. A fishpond com-

prises "deeps" and "shallows." The "deeps" are trenches full of water, some ten or twelve feet wide and five to six feet deep. The "shallows" consist of a kind of tableland supporting a sheet of water, which at the highest tides is not more than some 20 inches in depth. The banks surrounding the deeps and shallows are known as the "humps" (*bosses*).

Deeps, shallows, and humps constitute a little system in themselves, and a fishpond consists of a multiplicity of such systems.¹ The communication of the fishpond with the sea is assured by sluices pierced in the bottom of the dike. The bottom of the sluice, which is of concrete, slopes downward on either side of the gate, the slope seaward being 1 in 10 and the slope landward 1 in 20. The sluice-gate is of cast iron and is raised by means of a screw. Between the sluice and the pond is a "sleeve," or a net in the form of a truncated cone, 22 feet in length, and a finer net called the "inner frame." Between the sluice and the sea is an "outer frame." A length of 4.65 miles of dike is pierced by an average of twenty sluices served by seven men, and is backed by 625 acres of water, deeps and shallows.

¹ Fishponds are a very ancient device. We do not know for certain whether they owe their origin to China, but we may affirm, on the authority of the elder Pliny, that Lucinius Murena, about the year 110 B.C., had large fishponds laid out in the neighbourhood of Rome. The Romans had a taste for rare fish, for luxurious meals, and, in short, for all the paraphernalia of gourmandism; hence their elaborate fishponds. All the Roman nobles, Lucullus at their head, owned fishponds. The *muræna* and the gilt-head were the fish generally reared. Red mullet were also reared and were sold at a great price, as only two or three used to reach maturity out of several thousand. Thus among the Romans it was their wealth, which developed a love of luxury, that was responsible for the creation of fishponds, while in France they were the result of poverty, which sooner or later develops a thirst for wealth.

The physiology of a fishpond consists of two operations—emptying and filling (*“faire déboire” et “faire boire”*). To empty the pond the sluice-gate is raised about 2½ inches some two hours before the tide is high. This produces a current running from the pond to the sea ; a somewhat feeble current, which strains through the meshes of the “inner frame,” and invites the young fish and fry of the Arcachon basin to enter the pond. When the level is the same in the basin and in the fishpond the sluice-gate is completely raised. Then, the sea continuing to rise, a current flows from the sea into the pond, which is “made to drink.” During this operation the speed of the current, often very considerable, will draw a few more fry into the pond. As for those which have already entered, and the adults contained in the pond, they are prevented from leaving by the barrier formed by the conical “sleeve.” Finally the sluice-gate is closed. The ponds are thus partially emptied and refilled from the middle of April to the 1st of November, twelve days in the month and twice a day.

These fishponds are inhabited only by surface fish ; principally bar, whose fry appears at the end of July, white mullet (at the end of March), black mullet, big-headed mullet, jumping mullet (June to the end of September), the common gilt-head, eels, conger, and sometimes soles. In 1786 sardines were common in the fishponds of Arcachon. These various species of fish feed on insects, crustaceans, and algæ. The mullet are particularly fond of a plant known as *ruppelle*. In winter they are forced to take refuge in the “deeps,” as the level of the water is lowered until the “shallows” are left dry. In spring and summer the “shallows” are submerged. The shallowness of the water allows it to become heated by day and cooled by night ; the fish can

accordingly choose what temperature they will. When the young fish enters the pond it is rarely more than $2\frac{1}{2}$ inches long. It is allowed to grow for two or three years, and then weighs from 1 to $1\frac{1}{2}$ lbs. M. Millet estimates that a batch of 1,000 mullet fry will in two years furnish a ton of food. An acre of fishpond produces about 3 cwt. of fish each year. The fish are captured from September to Easter. They are taken in nets with meshes of 1·3 to 1·6 inches. The sluice is used to catch the eels (the outer frame is placed there for that purpose); in the course of March they are speared with five-pronged eel-spears.

The fishponds of Arcachon are the largest in France, though not the only ones. About 1866 M. Battandier, of Marennes, transformed his salt-marshes into fishponds. This transformation is becoming less and less uncommon on the Atlantic coast of France, for the preparation of salt is becoming less and less profitable since the intensive exploitation of the mines of rock-salt and the development of the Mediterranean salt-pans. Dr. Kemmerer, of the Ile de Ré, has sacrificed some of his oyster-parks by transforming them into fishponds for mullet, eels, soles, turbot, red mullet and sardines. The best-known fishponds to-day are those of Primel at Morlaix, Pont-l'Abbé, Concarneau, Lorient, Les Sables, and l'Eguille. At Trinité-sur-Mer, M. Despommiers has constructed some excellently equipped aquaria, to which I shall presently return. The fishponds of Sables-d'Olonne, or "fish-marshes" established at the mouths of the little watercourses, deserve a special mention. They differ from those of Arcachon in that their sluices are quite rudimentary; they consist of boards sliding between two parallel grooved uprights. One of these boards is pierced with an aperture in which is adjusted a device analogous to the "sleeve" of the Arcachon

sluice; it is known as the *borgnon*, and is a kind of dome or cone of osier. As the aperture in which the *borgnon* is fixed is always open, the waters of the fishpond escape at low tide in a little cascade. The Arcachon ponds are of the "closed" type, and those of the Vendée of the "open" type. The same species of fish are found, with a few soles, and sometimes turbot. Despite the cold and the wind, powerful enemies of these fish, an acre of water, according to M. Linyer, will furnish annually 132 lbs. of mullet and bar, 35 lbs. of eels, and 88 lbs. of inferior species.

In the Mediterranean the almost imperceptible tidal currents have to be supplemented by artificial means. Small watercourses are for this purpose diverted into the seaside lakes. It is indispensable, however, that the stream should give a constant current. As this condition is not often realised, and as the salt-marshes are profitable, there are practically no fishponds now in existence.¹ However, in 1864 M. Paul Vidal dug some basins at Port-de-Bouc, along the canal of La Molle. Each basin had an area of 28 to 34 square yards, and its average depth was 4 feet 10 inches. The "deeps" were 13 to 16 feet deep; the shallowest of the "shallows" were covered by only 8 inches of water. M. Vidal filled his fishponds with eels, mullet, and bar. He fed the eel-fry on small living fish, crushed crabs, earthworms and slugs; the mullet fry with sea-weeds, crushed mussels, and dead fish; the bar fry with crabs, shrimps, and gobies.² Placing in a fishpond 100 feet square 700

¹ There used to be one at La Peyrade, near Cette, but I do not know if it still exists.

² Food is not distributed continually. But M. Fabre-Domergue thinks that in such cases the fish eat one another, and that an abundant artificial diet would increase the yield. Perhaps: but at what an expense!

mullet fry, he found that they acquired a length of 11·8 inches in three years, and in five years a length of 19·7 inches. If we suppose a loss of two-thirds in three years, the 700 would be reduced to 233, worth, at 1 fr. 50 each, the sum of £14 for 30 square metres, or about £1,848 per acre. The bar gave about the same result. Unhappily M. Vidal did not continue his undertaking. In France it was forgotten; but an Englishman, Mr. Mathew Dunn, reproduced the system with success at Megavissey. M. Gobin has proposed an interesting method of increasing the value of the seaside lakes of Languedoc, which are so rich in salt-marshes. It would consist in combining the preparation of salt with the rearing of fish. In Languedoc the salt water has to be pumped up in order to pour it upon the evaporating pans. It would be easy to divert a certain quantity of this water towards a basin where it would be mingled with fresh water, drained from the neighbouring rivers, in the proportions most favourable to young fish and fry. Another scheme!

V

I hope I have shown, in the course of this chapter, what delicate transitions there are between reservations, transplantations in the open sea, transplantations in locked waters, the dams of the lagoons and seaside lakes, and fishponds. Here, in a continuous series, are five terms of increasing complexity, for the possibility of the last is ruled by the effective existence of the first. Yet fishponds are of very ancient origin, while reservations date almost from yesterday. The simple is often born of the complex. I remember that as a child I gave myself a great deal of trouble in trying to make sea-water to keep crabs and star-fish alive in the house. It was

only later that the very simple idea came to me of bringing, when I brought the fish, a bottle of real salt-water.

From the foregoing facts a conclusion is to be drawn upon which I wish to insist.

It is needless to remark that if we preserve, transplant, and rear fish with so much care, it is not from benevolence nor paternal solicitude towards the fish. Rather is the prudent fisherman like the African negro, who fattens his prisoners before selling or eating them. The protection of man resembles a small capital from which large dividends are expected.

Now, the use of dams and fishponds is a form of protection. Let us take a definite example already familiar to us. A thousand young mullet left unprotected in the sea and then devoured in the state of fry by a fish whose flesh may be utilised will not produce more than a pound of edible flesh, while the same quantity of fry, introduced and reared in a fishpond, produces more than a ton weight of excellent food.

So here, in round figures, is a ton of fish saved from certain loss. No one, not even the species, would have profited by the loss. Reduce the figures by half ; half a ton is still saved. Now, we must remember that a certain number of adult specimens will inevitably escape and continue to perpetuate the species.

The same is true of mullet, bars, eels, &c. ; so that the fisherman of the coast who constructs dams and fishponds intervenes as a protector of numerous edible species ; becomes, in short, a pisciculturalist.

CHAPTER VII

FISHERY AND SCIENCE

- I. Piscifecture—Its principle and methods—Criticism of its results—The laboratory of Flödwig. II. Azote in the economy of the ocean—The Conference of Stockholm (1899), and the Christiania programme (1901)—Theory and practice—Fishery charts. III. The fishery schools of the French coast—Professional and technical instruction—New fishing-grounds.

WE cannot, on general considerations, trace a very definite line between science and industry. For this reason I have chosen a very special criterion to divide this chapter from the last : a criterion of an economic order, which gives rise to the two following definitions : industrial intervention concerns all phenomena which manifest themselves by a pecuniary return, have a separate existence, and an immediate social value. Scientific intervention, not seeking a pecuniary return, is subject to the protection of private, public, or collective wealth, but endeavours to acquire a social value.

I

Piscifecture may legitimately claim to be of social value. It goes further than pisciculture, which limits itself to rearing fish ; it endeavours to “manufacture” fish. The first art is a nurse, the second a mother. It is based upon an observation of the Norwegian naturalist Sars, who in 1864 discovered that the eggs of the cod,

which float upon the surface, may be fertilised in a convenient receptacle, and will then develop in the normal manner. The discovery was extended to other species. Then the programme of pisciculture was decided upon : it was to obtain and fertilise eggs, to rear the young in an aquarium until they had attained a certain size, and to place them in the sea. Its object was proclaimed : to replenish exhausted fishing-grounds.

But was not this a futile labour ? Sabin Berthelot, Huxley, and Macintosh did not spare it in their writings, and the subject has been hotly discussed. It would certainly be puerile to seek to add to the formidable quantities of eggs which drift at the mercy of the currents. But the question does not assume this aspect. The struggle for life diminishes the number of individuals. M. Cann has shown that in the seasons of 1894, 1895, and 1896 the density of natural reproduction of soles between Tréport and Dunkirk varied as 1·1, ·3, and ·7 ; so that in 1895 the deficit amounted to three-quarters of the spawning effected in 1894. In short, our fishermen have to face a limited natural production. Now three conditions are possible : either the number of fishermen may be very small, so that an excess of fish remains ; or their number may be constant, and the available quantity of fish may remain constant ; or the number of fishermen may increase and the quantity of fish diminish. The latter case is the most frequent. In 1820 there were 26,870 fishermen on the coasts of France ; in 1900, nearly 100,000. Man therefore decreases the natural production of fish ; and by man I mean more especially the petty fisherman, whose devastating work in our coastal waters we have already considered. Consequently piscifactory will restore to the sea what it would have produced had man not multiplied his catches ; it

will re-establish the equilibrium. From the social point of view it appears as a remedy destined to cure the evil caused by the small fisherman ; that is, as a means of subsistence for those very men. The more the larvæ are kept in aquaria, says M. Fabre-Domergue very truly, the greater is the economy as compared with natural production. If, in nature, 6,000 fertilised eggs are indeed required to produce one single larva 15 days of age, it is manifest that the artificial production of larvæ will represent, not an equivalent number of larvæ, but a number proportional to that which would be necessary to assure the survival of our larvæ up to the day of their release. In other words, by rearing a single larva for 15 days the naturalist will compensate nature for the loss of 5,999 larvæ !

This is mere reasoning ; it is not an experimental result. Let us put the question : Yes or no, has marine piscifaculture resulted in more plentiful catches in any given region formerly depleted ? It is difficult to answer precisely. Captain Dannevig, Director of the Laboratory of Flödwig, in Norway, declares that from 1883 to 1898 1,800 millions of cod fry were thrown into the fjord, and that the annual expenses of the station amount to £612 for an annual production of 412 millions of fry, or 2,700 fry for each penny expended. And he also states that, according to the statistics, "the cod fishery is developing rapidly on the Norwegian coast, and the largest catches are made in the neighbourhoods which have been supplied with fry." But what grounds of error are there not in the evaluation, apparently so simple, of a phenomenon in reality so complex ! It is true that 412 millions of fry from $\cdot 2$ to $\cdot 4$ of an inch in length are released in the sea each year. But what do they represent among their fellows born among natural

surroundings? What is the number of the latter? and how many adult fish result from these millions of fry? The fishermen of Flödwig themselves do not agree as to the number of cod taken in the neighbourhood of the station. The laboratory at Dildoe, in Newfoundland, deals with more than 300 millions of eggs each year. As a rule one-third perish; the remainder furnish fry which are transported to Bonavista Bay and Conception Bay. It is as difficult at Dildoe as at Flödwig to estimate the effective yield of marine piscifaculture.*

In default of obvious practical results, marine piscifaculture has at least furnished us with a host of details relating to the embryogeny of fish; the most important being the fact that the breeder must feed the fry before the vitelline vesicle is entirely absorbed. This, according to M. Fabre-Domergue, author of the most valuable researches into the history of the sole, is an essential condition of success. My colleague and friend, M. Anthony, who, following the example of MM. Malard and Dantan, has most successfully undertaken the rearing of turbot, writes as follows: "Without waiting for the complete absorption of the vitellus, I began to feed the young larvæ, giving them each morning, in abundance, fresh living plankton, taken in the open sea and carefully strained on very fine bolting silk. . . . On the eleventh day the last traces of the vitellus had disappeared. I succeeded in rearing the larvæ up to the twenty-third day. They had passed the so-called critical period on

* There are laboratories at Gloucester, Wood's Holl (U.S.A.), Bay View (Canada), Dunbar (Scotland), Lowestoft, Haslemere, Plymouth (England), Boulogne, Saint-Waast-la-Hougue, Concarneau (France), &c. The Dunbar station is especially devoted to the piscifaculture of plaice. The principal species which have been reared in aquaria are blenny, plaice, herring, gurnards, cod, salmon, sole, and turbot.

the eighteenth or twentieth day." The water of the aquarium was maintained at a temperature of from 64.0° to 68.0°. But although copious nourishment is indispensable in the case of young fish, it does not appear to be very favourable to the maturing of the eggs of an adult kept in captivity. M. Fabre-Domergue even hinted, at the Congress of Maritime Fisheries, Bordeaux, that the absence of turbot's eggs in the establishment of M. Despommiers was due to the over-richness of the food distributed. The muscles of the fish probably developed more than their ovaries; indeed, a turbot readily gains from 2½ to 5½ lbs. in a year at the Trinité-sur-Mer establishment.

Marine pisciculture possesses a highly perfected technique of incubation. MM. Fabre-Domergue and Biérix, in the case of the sole, and M. Anthony in the case of the turbot, have employed a cylinder turning on its axis. This apparatus is partly analogous to that of Chester: a kind of bucket with four openings, the bottom being formed of woven wire. The receptacle containing the eggs is plunged into an aquarium, and the rotatory movement has the effect of continually renewing the water. This process is especially suited to floating eggs. I have no doubt that the incubators used in the culture of fresh-water fish are of great value; the communicating vessels of MacDonald, the jars of Chase, &c. As for eggs heavier than water (those of the salmon and shad, for example), it is enough to place them on a very fine perforated bottom and immerse them in troughs through which a continual current flows. M. Lestandi has installed at Gradignan, not far from Bordeaux, a model laboratory for the rearing of salmon. The fertilised eggs are placed in a moving cage, which is immersed in a little basin. The mortality of the fer-

tilised eggs, up to the moment of birth, is less than 2 per cent. The aquaria for the fry are of wood lined with zinc. The young are fed with the spleen of bullocks, reduced to a pulp and passed through a sieve.

Will marine piscifaculture ever attain a great industrial position? I do not think so. A river is one matter; the ocean is another. The Americans were easily able to replenish their rivers with shad, which had become extremely rare, and to acclimatise them in the rivers of the Pacific Coast, which they had never frequented; but this does not prove that one can repeople a gulf or a bay. However, the science should be encouraged, as its principle is correct and its methods serious, and because it is, like the fry it produces, an embryo which will develop.

II

To fabricate larvæ and to throw them into the sea: that is the direct method of replenishment. Let us consider all the conditions of the sea which are favourable to the prosperity of the various species; this is the indirect method. This leads us to oceanography.

The North Sea receives, year in, year out, according to Brandt, 487,000,000 kilogrammes (or about 487,000 tons) of azote in combination and in an utilisable condition; while its yield in the form of edible flesh is only 16,000,000 kilogrammes, or 16,000 tons.¹ It will be objected that, as all the fish in the North Sea are not captured, these figures do not express anything precisely. That is so; but if we remember that the North Sea is becoming poorer in fish they assume a great importance, for they show that a great quantity of combined and utilisable azote is not utilised. From this

¹ See p. 100.

the following ensues : since the fate of the azote depends, if I may say so, on the action of the nitrifying and denitrifying bacteria, we ought to look into the conditions capable of accelerating or checking this bacterial activity. Do not believe that such a process is merely a chimera : Professor Brandt has shown that the quantity of nitrates and nitrites diminishes in summer¹ because decomposition is accelerated, and that the addition of phosphate of calcium to sea-water causes a very notable increase of vegetable plankton. It would therefore be possible to "fatten" or "manure" a given area of the ocean as we fatten a field, or rather as we transform a prairie naturally exhausted into productive tilth. It is needless to say that this idea is in the region of pure theory ; but this is no reason why it may not one day be put into practice.

Let us now return to realities. It is essential for the fisherman that we should be acquainted with the sea and the biology of the edible species of fish, and the necessary researches are long and difficult, such as only trained scientists can undertake. For this reason Sweden, in 1899, convened an international conference for the study of the North Sea. England, Germany, Norway, Denmark, Holland, and Russia responded to the invitation. The conference instituted a series of experiments for a

¹ Quantities of ammonia and of azote in a litre of sea-water.

		AZOTE. (In the form of Ammonia.) Milligrammes.		AZOTE. (In the form of Nitrates and Nitrites.) Milligrammes.	
Baltic	February	...	'068	...	'199
	May	...	'065	...	'170
	August	...	'057	...	'095
North Sea	February	...	'063	...	'216
	May	...	'065	...	'217
	August	...	'061	...	'079

—Brandt, *Conseil perm. inter. explor. de la mer*, iii. 1902-4.

term of five years, dealing with trawling, the release of marked fish, the gathering of plankton, currents, and the temperature and salinity of the water. The first successes were so encouraging that two years later, in May, 1901, Norway convened a second conference at Christiania. The same nations were represented: France again held aloof. At the second conference the objects of research were determined in greater detail. The North Sea was divided into zones radiating from the Dogger Bank, and each of the signatory countries was entrusted with one or more zones. England furnished a vessel, the *Huxley*, and a sum of over £40,000 to be divided over three years; Germany, the *Poseidon* and an annual contribution of £8,000; Russia, the *Michael Sars* and £10,000. Norway and Sweden each subscribed £8,000 for a period of three years, and Denmark about £4,000. The programme was the same for each country. It dealt with:—

- a. The nature of the bottom.
- b. The nature and degree of abundance of animal life at the bottom, from the point of view of the nourishment it may afford the fish.
- c. The size and weight of the fish taken.
- d. The food of the more usual species; plankton.
- e. The conditions of sexual maturity and reproduction.
- f. The temperature at different depths and the action of the currents.

The "Permanent International Council for the Exploration of the North Sea," which sits at Copenhagen, has issued a score of large publications containing a host of oceanographical data, especially of the physico-chemical order. The reader who ventures among these enormous columns of figures is liable to gain an impression of chaos. Is all this scientific display indispensable? I

think not ; but the idea that it might one day be useful should be sufficient to save it from condemnation. Doubtless Dr. Brandt's theory originated in the study of such data. Nevertheless, from the standpoint of professional technique, we must not, as an orthodox disciple of Auguste Comte could do, subordinate the biology of the fish to the physiology of the ocean. The latter does not necessarily contain or imply all the elements of the former. The practice of fishery is not a necessary consequence of oceanography ; history proves as much. Both sciences must assuredly proceed side by side, and the prudent scientist will act on the inspiration, not only of his own principles and methods, but of the secular experience of seafarers, which he will submit to his peculiar methods, while seeking all desirable improvements of theirs.

The Christiania programme has been criticised as being too comprehensive. Some have claimed that the experiments, instead of being disseminated over so great a surface, should have been concentrated and confined to a limited area. To my mind the two methods should not exclude but complete one another. Certainly research should be limited to clearly defined objects ; to-day science lives by the monograph, which may be said to be a condition of exactitude. Moreover, such limitations impose themselves upon those who undertake marine research work. When M. Albert Glandez, vice-president of the Yacht Club of France, most generously placed at my disposal his yacht *Andrée* for an oceanographical campaign, my first care, before sailing, was to trace on the chart the zone of research decided upon. We must not, however, forget that all parts of the sea have a common solidarity, and that detail is often incomprehensible and unproductive, and remains a dead letter if not elucidated by the whole.

In France the technical service of the fisheries was instituted and organised by the decrees of May 24, 1862, and May 17, 1887. The Inspector-General of Maritime Fisheries is directly responsible to the Under-Secretary of State for the Marine. He is entrusted, by the terms of the decree of October 19, 1909, with the inspection of schools of fishery, with the study and popularisation of questions of science as applied to fishery, and with the supervision of fishery establishments from the hygienic point of view. He directs the "scientific service of the maritime fisheries." This service includes several naturalists appointed to the coast laboratories (at Boulogne, Roscoff, Concarneau, Baynuls-sur-Mer), who carry on research work dealing with the biology of fish, with plankton, and with the local methods of fishery.

The practical result of the Christiania programme and of inquiries of this kind in general will be the preparation of fishery charts, like those issued from the Scotch port of Aberdeen. To be effectual such charts must be the common work of scientists and of men acquainted with the technique of fishery. We shall find an example in the North. Norway has fishery experts in permanent residence abroad. The French experts—and here I agree with M. Canu—should be entrusted with frequent and important commissions: should draw up reports, in conjunction with our scientists, which would be rapidly printed and distributed, dealing with the oceanography of various seas and the practical conditions of various fisheries, the best methods of wholesale capture, and the best seasons, &c. If the shipowners of the north coast of France had such information to hand they would be able to resume the lucrative cod fishery on the Dogger, which has never been abandoned by the English. They would be able, like the English, to take

advantage of the movements of the cod as they gather off the Hebrides, the Butt of Lewis, and the North Minch. "In 1894," says M. Canu, "thanks to the translation of a report on the cruise of the Dutch guard-ship, the *Zeehoud*, I became aware of the custom of the Dutch herring-fishers of opening their season at Stornoway. By the very nature of my duties" (M. Canu being then Director of the *station aquicole* of Boulogne) "I was obliged to keep an eye year by year on the success of this Dutch fishery in the Hebrides, in order to report it to our French fishermen and convince them of its value. . . . In 1897 a Boulogne master-fisherman (*patron de pêche*) sampled the cod-fishing at sea off the Hebrides, working towards the south, before the opening of the usual fishery to the west of the Shetlands, and Foula and Fair Island. This attempt miscarried, owing to a lack of technical data relating to the sequence of the cod and herring fishery of Stornoway. In 1898 the same man made a second attempt, and this time followed the methods employed by the Dutch; the result being a remarkable success in the mixed fishery of cod and herring. If this success is maintained our herring ports will certainly despatch their fleets for a new season of mixed fishery in the Hebrides." *

III

Your fishery charts, more than one sceptic will cry, are doubtless an excellent reform; but it would be as well if

* The "prime" herring fishery in the North Sea commences in early summer.

"France has lately established a cod fishery in the Hebrides, but there does not seem to be any great movement among our ship-owners. . . . The fishermen of Gravelines, who are the only men to fish in these waters, now usually frequent the Shetlands, and a few the Orkneys." (Central Committee of Shipowners' Circular, June 10, 1903.)

This abstention is largely due to lack of information.

our fishermen knew how to read them ! It is certainly true that in many cases their ignorance is only equalled by their disregard of danger. We have seen master-fishers engaged in the tunny fishery who have deliberately gone to sea with no other instrument than an ill-regulated compass ; who, when the time has come to make the land once more, turn their bows to the east without more ado, so that they often make Point Ortegal or Vigo Bay instead of Ushant or Penmarck ! Courage and endurance are noble virtues, of the greatest value in moments of crisis, but in everyday life a little knowledge is of great utility. The Schools of Fishery scattered along our coasts and the "Society for Professional and Technical Instruction in Maritime Fishery" have undertaken the duty of educating our fishermen.

One of the earliest schools was that of M. Victor Guillard in the Ile de Groix. For a long time these schools were isolated. It was only last year that the Under-Secretary for the Marine, by granting them an official charter, co-ordinated their efforts. The schools of fishery are organised by the State, the departments, the communes, or by the initiative of private societies or individuals. They may be subsidised by the Government, on the condition that they submit their curriculum and the appointment of their staff to the control and approval of the Minister of the Marine. The courses of instruction deal with the elements of navigation (landmarks, alignments, lighthouses, buoys, beacons, sea-marks, reading charts, latitude and longitude), with the various fishing-grounds and the fish frequenting them, currents, steam-engines and motors, and hygiene on ship-board, &c. An additional subject should be an explanation of the methods employed in foreign fisheries. A

diploma is given which will ultimately carry with it certain advantages of a military order.

The "Society for Professional and Technical Instruction in Maritime Fishery" was founded some fifteen years ago by M. Cacheux. M. Coutant is the president, and M. Pérard the general secretary. Its object is "the development of maritime fisheries and the improvement of the condition of the sea-going fishermen. It institutes, with this object, professional schools of fishery, courses for adults, and museums of fishery. It organises congresses,¹ exhibitions, and competitive examinations." It distributes subsidies and material to the schools of fishery already in existence. At Concarneau it has a motor training-vessel, the *Goéland*, which from October to July serves as a "floating annex" to the fishery schools of Finistère, while during August and September it is employed in oceanographical researches.² Finally, since last year it has formed autonomous sections at certain points of the coast, which will organise and administer schools of fishery under its direction and control.

The nations of Northern Europe possess similar institutions. In Belgium they are State-supported; but elsewhere the Government usually confines itself to contributing grants. A Norwegian society has established a fisheries museum at Bergen, which is the finest I have seen; and a "trial station," where theoretical and practi-

¹ Every two years the National Congress meets in some seaport town. Last year it met at Sables-d'Olonne; in 1907 at Bordeaux.

² The agricultural station at Boulogne, of which M. Cligny is the director, also possesses a steamboat, *La Manche*, provided with a live-tank. The Department of the Navy has also placed at the disposal of the Inspector-General of Fisheries, M. Fabre-Domergue, an old scout or despatch-boat, *Le Pétrel*. The maritime laboratories lend naturalists and fishing experts their own boats; the *Plutæus* and the *Cachalot* at Roscoff, and the *Roland* at Banyuls-sur-Mer.

cal classes are held for the future managers and foremen of preserving factories, factories of fish farina or fish oil, smoking and curing establishments, &c. Most of the European schools give a special diploma, without which no one may command a fishing-vessel. In France the question is under consideration. There is some talk of establishing two diplomas, those of deep-sea master-fisherman and off-shore master-fisherman (*patron de pêche au large, patron de pêche côtière*).

"Rome is falling ; let us fly to the Fortunate Islands," said the cynical Horace. M. Victor Guillard would seem to have expounded this doctrine when he counselled the fishermen of France to seek in the open sea the fish that they failed to find upon the coast. But to gain the open sea and return to port surely and speedily they require some knowledge of navigation. The exploitation of the new fishing-grounds discovered by the naturalists is thus dependent upon a knowledge of navigation.

M. Guillard's cruises of investigation on board the *Jeanne* carry us back to a period twenty-three years ago. The distinguished Director of the School of Fishery of Groix proved long ago that there exist enormous quantities of fish at the bottom on the belt of ooze which stretches, at a distance of about 50 miles from the coast, between Cobra Point and Point Race, and also on the sandy belt which lies beyond the former. Soles, hake, gurnards, and rays abound at depths of 60 to 70 fathoms. Moreover, he showed that upon the sandy zone, whose width averages nearly 70 miles, there are the finest soles and turbot. He also stated that at this distance the sea is less rough than upon the coast, and far less rough than the Channel or the entrance of the Gironde. The "New Bank"—for so he baptized this ocean bank—is still visited by trawlers to-day ; but less frequently than of

old, for the fishing-grounds of to-day are still further from the shore. M. Guillard himself has contributed to this outward movement. On the *Caudan*, in 1893, he sank his basket-traps at the base of the Chapel shoal, and captured cod similar to those of Newfoundland.

It is useful to recall these facts. The cry "further to sea" has prevailed under the stress of economic necessities. It has resulted in the partial substitution of large vessels for small, and in many places the sail has been displaced by the steam-engine. But the movement is only in its infancy. The cry "further to sea" is synonymous with "further from home." It is a mere matter of latitude and longitude; for are not the off-shore fisheries of Newfoundland, despite their proximity to land, at a very great distance from the men of Fécamp?

In elucidating such details of oceanography as I have given in the early chapters of this book and the new discoveries and results which will be obtained in the laboratory and by practical fishermen, naturalists will find fresh fishing-grounds for exploitation. The discovery of such grounds is certain, though not always a simple matter, but it is simpler than the discovery of the capital necessary to the profitable working of such grounds.

M. Canu wished the French fishermen to frequent the Hebrides. M. Cligny has shown us that there are fishing-grounds to the north of the Farões, and to the north of Iceland, and in the British Channel. The Baie du Lévrier is still waiting for the numerous trawlers for which its fertility calls. The shores of the French Congo are waiting for the installation of fisheries: to the north of Libreville the creek of Mondah offers an asylum to enormous shoals of mullet; while Cape Lopez Bay and Loango Bay are equally rich in fish. The Portuguese have commenced to fish in the neighbourhood of

Kabindah, and pour their products into French Congo. M. André Bouyat has been instructed by the Government of Uruguay to organise fisheries in the Bay of Monte Video. Last year the Government of Ecuador called the attention of its shipowners to the untouched banks of the Galapagos Islands. The fisheries off the Kerguelen Islands, which are scarcely two years old, are fully answering the expectations based upon them; but, according to their custom, the French capitalists have turned a deaf ear to all the appeals of the concessionaires: the latter have been obliged to obtain the money required to give life to a French colony from such a poor country as Norway. M. Bounhiol has charted the practicable fishing-grounds off the coast of Algeria. These represent a total area of 5,600 square miles, of which barely 1,500 have been exploited. At the end of his remarkable monograph upon Maritime Algeria M. Bounhiol writes: "The fishing-grounds at present untouched are fertile, as I have proved by exhaustive experiments. They come under two headings. The first category consist of grounds rich in fish, bordering upon long stretches of country in which fishermen and fisheries are unknown; such as Dahra, Kabylia, &c. The second consist of the often very considerable margins of the fishing-grounds already utilised, which are as yet untouched as the fishermen will not work further out to sea." After serious inquiry the Grimsby trawlers have been sent to fish in the White Sea.¹

¹ A three- or four-mile territorial limit, such as is customary in Europe, gave the English trawlers a free entry to the White Sea, where they obtained magnificent catches. A few months ago Russia claimed, and will apparently succeed in imposing, a nine-mile territorial limit, which excludes all foreign vessels from the best portions of the White Sea.—[TRANS.]

It is useless to give further examples. The supply at present appears to be greater than the demand, nevertheless it is of the greatest importance that our fishermen should break through their accustomed routine, and, without entirely breaking with the past, should learn to profit by the information offered them by science.

CHAPTER VIII

FISHERY PROBLEMS

- I. Local distribution of fish : movements and migrations are not extensive. II. The dependence of fish upon their surroundings—The herring of the Kattegat—Miraculous catches in the estuary of the Elbe. III. Comparative independence of fish—Defence and attack—Hereditary instincts. IV. Special adaptation—The critical oceanic condition and the critical biological condition—The law of fishing-grounds. V. Practical consequences of this law—Experiments of the Fishery Board of Scotland—Virgin grounds—Matters of exploitation—The fisheries of the future.

THE French mind loves generalisations ; it would rather have erroneous generalisations than none at all. I shall therefore attempt, I hope not too timidly, to make the expected synthesis from the foregoing accumulation of material. To be precise, it will be merely a summary, supported by certain fresh examples of a less special bearing, and followed by the general considerations which arise therefrom. This chapter may be regarded as the skeleton of the entire book.

I

The edible fish of commerce are almost entirely distributed over the continental plateau. They avoid the oceanic abysses many thousands of feet in depth. The researches of Hjort in the Norwegian Sea, of Holt in the North Sea, and of the recent hauls of M. Fabre-

Domergue in the Bay of Biscay, on board the *Vienne*, have shown that beyond a depth of 80 fathoms the sole, turbot, and brill are no longer found.¹ Towards a depth of 160 fathoms in the Atlantic a few flat-fish of the more valued species are to be found, including the merry-sole (*P. megastoma*), together with hake and certain Mediterranean species. On the slope of the continental plateau the capture of deep-sea forms of the *Macruridæ* warns us that between 160 and 270 fathoms the marine fauna has undergone a radical transformation; there are no more edible fish. There are therefore no fishing-grounds at a greater depth than 1,600 feet; and those which can be fished with profit are in less than 660 feet, or 110 fathoms. In none of the depths explored have young immature flat-fish been found.

Whatever their species, fish are always on the move. Two hauls of the trawl made in the same locality at an interval of three or four hours will often give different results. But the amplitude of their movements is very small as compared with the vast extent of the seas. These movements affect masses of fish; sometimes whole groups of species at once; sometimes one species after another; but they never take any species beyond the limits of its normal habitat. The menhaden or American herring is unknown in Europe. The Baltic herring forms a separate race, of smaller size than the English herring. There are almost as many races as localities. The Dutch adult herring is a large fish; on the banks of Iceland, in the Shetlands, and in Norway, the herring is still longer and heavier: 400 Iceland herring will fill a barrel, while 800 Channel herring are required. The herring of the Zuyder Zee is not

¹ One single specimen of sole was taken from a depth of 120 fathoms near the bottom of the Arguin bank.

the same as that of the Dutch sea-coast ; the Dogger herring is of a special race. In the North Sea alone there are three or four distinct races of autumn ¹ herring, and as many of spring herring. The races do not mingle. The herring of one region never show themselves in another region—at all events, not in the form of shoals. In the Channel adult herring are taken now and then from the bottom, with the trawl, at *all* seasons of the year. In summer they are sometimes taken together with mackerel. Three years ago, in the month of October, the fishermen of Boulogne surprised hundreds of thousands of herring in the estuary of the Thames. Mackerel are perhaps even more narrowly localised than herring. The American races differ from the European races. The Irish mackerel differs from that of Plymouth. It is the same with the sardine, the cod, and with flat-fish. In short, direct observation and experiments with marked fish prove the law already enunciated, that the seas are divided into an infinite number of provinces, each provided with its own population, and that a species *never leaves the confines of its proper habitat*, keeping to its own quarter somewhat as the dogs of Constantinople used to do.

The history of the earth, in this connection, comes to the aid of oceanography ; thereby only paying a just debt, for in many instances the oceanography of to-day explains the geology of the morrow. The two shores of the Isthmus of Panama, formerly a strait, nourish the same fish ; 30 per cent. are species common to either side. The fish of the Ligurian coast and those of Corsica, Sardinia, and western Italy are the same, because the African continent formerly projected far into the north. On the other hand, there is no such similarity

¹ Herring spawning in autumn.

between the marine fauna of the coasts of Spain and Languedoc. We see, therefore, that important geological upheavals have by no means modified the primitive habitat of certain species, which have remained faithful to them.

Plankton is carried by the ocean currents, but fish always swim against the currents. They have only to open their mouths as they swim in order to obtain abundant nourishment; and the more they swim the more food they obtain and the more surely they sustain their strength. The extent of the movement of masses of fish is thus a function of the extent of their alimentary needs. It is at the moment of spawning—an operation which weakens them—that the need of nourishment is greatest, and at the same time the movements are most extensive. The concordance of the two phenomena is of very ancient origin. It has given birth, in the course of the ages, to an invincible hereditary instinct, the result of which is migration. Like the casual movements of fish, the annual migrations are strictly limited. The herring of the Channel and those of the Dogger migrate separately. The spring herring of the North Sea confine themselves to local movements; they are almost sedentary, and remain all the year round in the neighbourhood of the coast. The mackerel of the Channel do not leave the Channel after spawning; when, in the winter, they disappear from the surface, they plunge into some twenty-five or thirty fathoms and simply take refuge on the bottom, gathered in enormous compact shoals, covering the sandy belts inshore like a carpet.

II

All living creatures are dependent upon their environment. The greater portion of modern biological research

is based upon this principle. It is easy to select instances of fish upon which their hydrographic surroundings produce a visible effect.

The codfish spawns in winter and in comparatively warm waters. In Iceland it finds them between Portland and Cape Skagen; it also finds them in the fjords to the west. Spawning over, it makes for the northern shores, to regain the cold waters in which it lives. According to the old Swedish chronicles, the herring of the Kattegat are subject to periodical revolutions. For some sixty consecutive years they show themselves along the shores; then they depart, and remain absent for another sixty years. They return again, and again depart, and so on through the centuries. This is perfectly true. M. Cligny has given us an excellent summary of the investigations conducted in this connection by the Scandinavian oceanographers: "The Skagerack is a cross-roads in which three distinct currents meet with a regular periodicity; in spring, after the snows are thawed, when the rivers are swollen, the Baltic overflows, and fills the straits with water which is noticeably deficient in salt. Under a very thick layer of this Baltic water we find a thin layer of average salinity, similar to that of the North Sea, and lower still a very salt layer, said to be oceanic water, which comes, there are reasons for thinking, from the North Atlantic, between Iceland and Scotland.¹ Matters remain in this condition during the summer; but in autumn the North Sea water

¹ Salinity: Oceanic water, '035; North Sea water, '034; water of the inshore banks, '032 to '039. The plankton of the first and second consists more especially of diatoms; that of the third of crustaceæ, entomostraceæ, and ciliata. Duhamel du Monceau states that the sardine deserted the neighbourhood of Saint-Jean-de-Luz from 1759 to 1774.

makes an irruption into the Skagerack by way of the Jutland banks (shoal water); it pushes the Baltic water back to the shores, and expels even the oceanic water, which by the winter can only be found at the bottom of the deepest depressions. Now, the Scandinavian hydrographers have believed this movement of the waters to coincide with the approach of the herring to land; they even state that the herring hug the land closer as the invasion of the shoal water is more energetic; and that even in its changes and oscillations the herring obey the successive impulses of the new current. It would be rash to seek, as some have done, the part played by the elementary factors in these movements of the herring; the temperature and salinity of the water, and the dynamic action of the current may perhaps play only an indirect part in these movements; nevertheless these conditions must greatly affect the multiplication of the infinitesimal creatures on which the herring feed. In any case, there remains one crude fact: the coincidence of the movement of the waters with the arrival of the herring; and the conclusion that the herring has adapted itself to these annual changes. For this reason it is legitimate to connect any notable change in the habits of the herring with a change in the cycle of the currents."

Mr. Walter Garstang has published some curious observations relating to the mackerel of the Channel. There was a scarcity of this fish in the February and the March of 1896 and 1898, but in 1897 it was abundant. The cause resided in the fact that in 1897 the winds of February and March had blown from the south-west, so that the warmer waters of the Atlantic caused a rise of temperature in the Channel; during the other two seasons the winds had blown from the opposite

quarter.¹ The tunny is found principally in waters whose temperature varies between 55·4° and 68°. When I was visiting Bergen, Herr Nordgaard told me that those fjords whose bottom temperature was less than 43° contained many animal species proper to the glacial seas, while in others the fauna was of a more southern character.

It is true that oceanic conditions do not always act upon fish in a direct manner. They act indirectly, the intermediary being plankton. Indirect action is far more frequent, for plankton being more simple is more sensible to external agencies. Plankton, if I may so express myself, is less remote from mineral matter than the fish, and is in closer communion with it. To expound the whole truth of this assertion it would be necessary to expound the whole science of oceanography. I will rather cite a very precise and plainly synthetical instance described by Herr Volk. In 1904, at the end of a long period of drought, the waters of the Elbe were low. The hydrographic conditions of the estuary were perceptibly modified ; the average temperature was increased, and the salinity also. The river had scarcely commenced to rise once more when prodigious quantities of organic substances of all kinds began to flow down to the sea. Vegetable plankton immediately appeared in the estuary ; it assimilated the nutritive substances, developed, and multiplied itself in dense, thick layers. The quantity per litre was three times as much as in the preceding year. In the lower reaches of the river a cubic metre of water contained 460 grammes of vegetable plankton (*Eurytemora*), or 45 grammes of dry material. In short, at any given moment there was, between Hamburg and

¹ The sardine fishers of Provence have a saying, "All currents that flow from the land are bad ; all currents that flow towards the land are good."

Altona, some 540 tons of assimilable alimentary matter. The animal plankton in its turn fed upon this prey: assimilated it, developed, and multiplied itself in dense, thick layers. Small crustaceans and rotifers abounded. The table being served, the places were quickly taken by fishes of all species. There was an invasion of flat-fish, soles, plaice, flounders, dabs, turbot, and especially of brill. Their abundance was so great that many perished in the struggle for life.

III

The dependence, direct and indirect, of the edible fishes upon their ocean environment is sufficiently obvious; but where does it begin and where end? In other words, how does the fish "strike the balance" with its environment? This is a very difficult question, to which we can only give an apology for an answer.

The employment of the facile criterion of temperature, and perhaps a desire to justify it, has resulted in the introduction of narrow and exclusive ideas into science. According to these ideas, a given species cannot disport itself until the thermometer marks a given degree. The truth is not so simple. Fish can support great differences of temperature. Sardines are supposed to be extremely delicate; yet they have been found in the Bay of Biscay in midwinter, when the surface water was at 50°, testifying an evident appetite for *rogue*. The fishers of Arcachon lose no opportunity of catching them, although they have to light fires on their boats to thaw their nets. M. Camille Mader is therefore absolutely in the right when he says that "excessive cold does not cause the exodus of the sardine, and does not prevent a few shoals or individuals becoming temporarily pelagic, despite the lowered temperature of the surface of

the sea." The maximum temperature of waters frequented by sardines is 68° . "Above this temperature," says M. Mader, "the sardines leave the surface and search for better conditions in the submarine layers of the sea." In the case of the herring, M. Canu has shown that the range of temperature is 27° ; the minimum being 39.2° in January and the maximum 66.2° in November. In the case of the tunny the range is 12.6° . The mackerel and the cod readily pass from cold to warm water. Moreover, the fact that fifteen species are common to the North Sea, the North and the South Atlantic, and the Mediterranean is sufficient proof of the great tolerance of fish as regards temperature¹ and of their tolerance as regards salinity,² for the two factors are closely connected. What is the cause of this tolerance? Life itself.

Thanks to assimilation, which transforms food into muscles, blood, and bones, the living creature is in a state of continual transformation; it is a marvellously complicated mechanism, which at all times is demolishing and reconstructing itself; it is a piece of mechanism in unstable equilibrium. According to the phrase of M. Le Dantec, existence is a struggle and life is a victory. Fish, in consequence, represent a continual triumph. But, it may be asked, over what is their triumph? Over their environment; over the medium that envelops them. Although they are the lowest of the vertebrates, they occupy a very high position in the zoological scale. Placed in inclement surroundings, they resist them—instance the sardines in water at 50° —but in the face of danger, of certain death, or perhaps I should say before the approach of certain defeat, they respond—instance the herring of the Kattegat—somewhat as did the Russians before Napoleon, proving to mankind that flight some-

¹ See p. 30.

² See p. 71.

times leads to victory. Woe to the loiterers!—they perish. The gilt-heads and young sardines, which allow themselves to be surprised during the winter in the fish-pond of Berre by a sharp and sudden frost, die in shoals. Yet, despite the suddenness of the attack, there are some that triumph ; those which have been able to bury themselves in the protective mud. In 1878 many of the codfish of the Nantucket shoals died of the cold. When the danger had passed the survivors reappeared to struggle and to conquer. Thus the fishermen of the Frisian islands, almost year after year, build their huts in the same place, although they have been laid flat by the storms. Thus the people of Messina rebuilt their city, destroyed by earthquake, on the same site.¹

The fishes have to support not only the onslaught of nature, but the attacks of the more powerful among themselves. The struggle for life in the depths of the sea is pitiless. We see in Dublin Museum a fishing-frog (angler-fish) still swollen by an enormous codfish which it had swallowed ; in the stomach of the cod are two large herring ; in each herring several sprats ; in each sprat a mixture composed of minute crustaceans, algæ, and plankton of various kinds ; and from the plankton to the cod the forms and tissues of the animals and algæ are so well preserved that the successive tragedies must have been enacted within the space of half an hour. The *menu* changes with the strength and size of the diner and of his jaws.

Those eat who are worthy of their meal. Pollack

¹ The Lisbon earthquake of 1755 was felt as far as the Straits of Gibraltar. Before this period, the tunny used to frequent the Spanish side. After the earthquake this became so shallow that the tunny could no longer pass without danger. They went by on the other side.

assemble in shoals to pursue the "banks" of young cod. They completely surround them, isolate them, and drive them to the surface, or to the shore, where they fall upon them. Hake pursue the "banks" of sardine. Whiting pursue the shoals of herring. The fry of the sole pursue a complicated strategy before catching their prey.¹ If the species seem to have preference for this or the other form of diet, they change it readily if it fails. When there are no hares, one eats rabbit. Do not the fish in the fishponds eat insects, plants, and prepared foods such

¹ The fishing-frogs devour enormous quantities of fish. It is not uncommon to find in the stomach of one angler-fish as many as a score of flounders or fifty or sixty herring. Here are the names of a few fish, the names in brackets being those of the fish on which they most habitually feed: Angler-fish, fishing-frog (chiefly soles, flounders, and herring); plaice (molluscs, in particular the solen, annelidæ, and small fish); coalfish (young codfish, launces); conger (the females, which are stronger and more numerous than the males, devour the latter, also soles); black conger (crustaceans); gilt-head (mullet, periwinkles); haddocks (young cod, launces); white tunny (mullet, anchovies, sardines, flying-fish); gurnards (raising the stones with their "fingers," molluscs and small crustaceans); herring (young launces, molluscs, annelidæ, and especially very minute crustacean of the genus *Temora*, 60,000 of which have been found in a single stomach, and algæ of the phosphorescent species); wrass (molluscs and crustaceans); pollack (small cod); dabs (small fish); mackerel (all fish and fry); whiting (herring and their eggs); hake (sardines, mackerel); cod (larvæ, fish of all sorts, molluscs, crustaceans); grey mullet (masticate the sand and strain the alimentary constituents with their pharyngeal sieve); bream (vegetables, molluscs, shrimps); young whiting-pout (small crustaceans); adults (larvæ of fish); John Dory (sprats, false smelt, molluscs); rays (all fish, crabs); sardines (copepoda, molluscs, diatoms—as many as 30,000,000 in one stomach); adult sole (worms, no longer hunts its prey); sole fry (just out of the egg, infusoria); later, the fry of pelagic sprats; later, young pout; flounders, plaice; before transformation into the adult form young soles devour one another, even when of equal size); older fry (the larvæ of rockling).

as the spleen of bullocks? Bar will eat sometimes fish, sometimes crustaceans, sometimes marine algæ, sometimes fresh-water plants, sometimes the refuse poured out by the sewers. Bream live sometimes on vegetable food, sometimes on worms, sometimes on fish; herring on sand-eels, molluscs, annelidæ, and pelagic crustaceans; sardines on pelagic crustaceans, the larvæ of molluscs, and microscopic algæ.

Attack provokes defence. The two words, in short, denote two aspects of the same thing. The weever, with its poisonous spines, attacks weaker fish than itself and defends itself against the stronger. The young sole, by covering itself with sand, conceals itself both from the prey it is waiting for and from its enemy. Means of defence are legion. Their variety enables the naturalist to comprehend the general plasticity of the living organism. The crabs live in isolation, the better to hide themselves, or gather together in order to present a larger front of resistance. They keep near the shore, out of the way of the large carnivora of the ocean. In the shelter of the rocks we find the sar, girella, bream, and gurnards. Behind the muddy curtain of the shore waters we find the *rascasse*, or sea-frog, another gurnard. Further out are the weevers, which half bury themselves in the sand. Still further inshore are the sand-eels, which bury themselves completely, and the bull's-heads or miller's-thumbs (*Cottidæ*), which we find at low tide crouching at the bottom of little pools.

Not only do fish take the greatest possible advantage of their surroundings, but they mimic them, and being almost indistinguishable from them, they pass unperceived. The wrass and young flying-fish take on the colours of the rocks and the seaweeds which surround them. The coloration of the sole harmonises with that

of the sand in which it lies. Placed in an aquarium with a white bottom, soles become plain and light-coloured ; placed on a slate bottom, they grow dark. Placed on a bed of variegated gravel, they become marbled. The fish of the Sargasso Sea have bizarre shapes which remind one of the Sargasso weed.¹

Such adaptations are the fruit of ages. The living creature lives by its past rather than by the present ; it retains intact in its inherited patrimony the experience handed down by generations of ancestors, thanks to which it has triumphed. The instincts and habits of to-day are the instincts and habits which have been slowly acquired by the species during the ages. The children of experience and natural selection, they are invincible. I need not again refer to the origin nor to the regularity of the migration of the salmon at the spawning season,² but I may take this opportunity of offering fresh proofs of the constancy of some of the more important species and their attachment to their ancestral breeding-grounds.

When, at the end of the ninth century, the Normans and the Basques, driven out of the North Sea by the Dutch, began to hunt the whale in the West Atlantic, they discovered America nearly five centuries before Christopher Columbus, and in the neighbourhood of the "New Lands" (Newfoundland) they caught enormous quantities of cod, as do the men of Fécamp and St. Malo to-day. Every one knows that Yarmouth-Lowestoft is the greatest herring port in the world. As

¹ The sargasso, sargasso weed, or sea-grape, is a ramifying alga provided with spherical buoys. The currents tear them from the coasts of Mexico and Florida and drive them into a calm belt a little south of the Azores, where they accumulate and form the Sargasso Sea.

² See p. 26.

early as the year 670 A.D. the revenues of the town were such that the Abbey of Barking levied a tax upon the fishery. Under William the Conqueror St. Edmund's Abbey received an annual due of 60,000 herring. In 1088 the Duke of Normandy permitted the Abbey of Sainte Trinité at Fécamp to hold a herring fair. To-day Fécamp is, with Boulogne, our greatest herring centre. In the twelfth century, as now, there was a busy herring fishery along the coasts of Scotland, in the Channel, and in the Baltic. There was a great demand in the market for mackerel. In 1364 the men of Dieppe and Rouen discovered the coasts of Senegal and of Guinea, and instituted a fishery there. Later the Portuguese exploited the slopes of the Arguin bank and the Baie du Lévrier, carrying on their fishery from 1444 until 1536, when they were expelled by the inhabitants of the Canaries. In the seventeenth and eighteenth centuries the Spaniards of Vigo Bay, the Basques of Cap Breton, and the fishermen of the Chaume d'Olonne caught large quantities of sardines, and the sale of the fish yielded the principal revenue of the bishopric of Compostella. About the year 920 A.D. grey mullet must have swarmed in the fishponds of Les Martigues, since the Archbishop of Arles purchased the fishery at that date. Pliny the Elder gives a capital description of the tunny fisheries of the Hellespont and the Bosphorus.

I think I am not mistaken in stating that the dependence of the fish upon its own history is sufficiently established. It is complicated by a dependence upon psychological and social factors. Pretentious as these epithets may seem, I do not hesitate to employ them, as I think they are justified by the fact. In the same bank of sardines the males are often further from sexual maturity than the females. At the end of winter

and in the early spring the Arcachon fishermen often take in the same bank specimens of various sizes whose genital organs are unequally developed. The second fact : sardines often shelter a parasite, and the majority of those thus infested are sterile ; nevertheless they mingle with healthy individuals and approach the coast in the same bank. The third fact : the herring which come to the surface and enter the bays to spawn are not all full of ova. In the neighbourhood of the Shetlands a good fifth of them are sterile ; nevertheless these sterile individuals join the others in the same shoal and follow them. Now, the shoals of herring migrate only in order to spawn, and to find after spawning a copious supply of food. Consequently those fish which are unable to spawn should not be found with the shoal. Nevertheless they do form part of it. We can only explain their action as the result of imitation, a psychological and social factor. The simplest observation will reveal the existence of veritable societies, founded upon a community of requirements, of bream, sar, and gilt-heads. Finally, I must not fail to mention the paternal instinct of the *Cottus scorpius*, which carefully watches the eggs when laid, and of the blennies, which, according to M. Guitel, actually solicit the gravid females and invite them to deposit their eggs beside those which they are already guarding.

As we see, to resist the hostile ocean and its enemies, in short, to eat and perpetuate its species, the fish is forced to employ all manner of ruses. It cheats its environment and it "bilks" its fellows. The essential matter is to find a place in nature. That place once conquered, the species accommodates itself to nature as best it can, and in the absence of some sudden catastrophe it no longer changes and remains always faithful to the

habits and traditions of its ancestors. It lives as best it can, incessantly tossed about between life easy and spacious, life strenuous and difficult, and inevitable death. It is precisely between these two limits that it asserts its momentary independence of its environment. The expression is unfortunate, I know, and betrays our ignorance of the incredible complexity of biological determinism; but it also expresses the incontestable truth that the independence of the fish in respect of this element or that of its present environment results from its dependence on its own history.

IV

The profound and definite individuality of the fish is manifested in many ways.

There is a general law which impels all living creatures to tend to leave their own domain. Not all succeed, but all try. The *zostera*, those marine plants which form the coastwise sea-meadows, grew of old in the open air. The sardines of the Breton straits frequently leap out of water. M. Racovitza once observed, in Rosas Bay, a shoal of anchovies which was attacked by a bank of mackerel. The unfortunate fish were collected in a compact mass, in the midst of which there was no longer any water. The mass of living, struggling creatures assumed the form of a cylinder; it was animated by three kinds of movements: a movement of translation, a gyratory movement, and an up and down movement; and the upper portions sought to escape into the atmosphere. The grey mullet are a leaping species. Turning on their sides in the water, and bending their bodies in an arc, they leap up and along to a great distance. Eels in making their way back to the sea often leave the rivers and wriggle through the grass. Certain exotic fish, like

the *Anabas scandens*, can climb a tree. The dactylopterus or "flying gurnard" of the Mediterranean can both swim and fly a distance of 100 to 200 yards, by the aid of its pectoral fins, which are three-fifths the length of the fish. The fifty species of exocætae, or flying-fish, fly in flocks for hundreds of yards. Whether it is the necessity of obtaining food or a necessity of defence that drives these creatures out of their usual environment matters little for the moment; the essential fact is that the phenomenon exists, and thanks to the action of time has given rise to special adaptation. This exodus followed by return operates within the narrow limits of the normal habitat. The first zostera, now marine plants, came of old from the shore. The first flying-fish and the first leaping fish leapt and flew above their proper region. Imagine the dogs of Constantinople beginning to live in the brooks, the sewers, and the puddles of their respective quarters; in a word, leaving their environment without leaving their quarters!

This remark does not apply only to the striking and exceptional cases which I have just described, but also to the very numerous and frequent and therefore normal cases which I am about to consider. What shall we say of the sea-trout, the shad; the sturgeons, the salmon, and the Seine smelt, which ascend our rivers at spawning-time; of the bar, dabs, plaice, and even soles, which cross the limits of our estuaries; of the dabs or flounders of our rivers, which venture as far as Andelys, Malines, and Gand; of the eels, which make their way to the sea—if not that they all radically change their environment? And what else do all the other species which come in-shore in shoals to spawn and to obtain more plentiful food—the bull-head and the gilt-head, omber and grey mullet, which penetrate the creeks, salt-marshes, lagoons, and fishponds of the coast in their search for brackish

water? And all those species which rush to the coast, into our estuaries, creeks, and bays, wherever the water is shallow: herring, sardines, cod, mackerel, rays, gurnards, and tunny? And the soles and all the flat-fish which come to spawn along the coast? And their fry, born of pelagic eggs, and swept hither and thither by the currents: these also, despite the currents, find their way back to the coast. The very young plaice of the Danish coast make an irruption into the brackish basins of Lüm-fjord. The fry of bar, gobies, grey mullet, false smelt, eels, gilt-heads, conger, and turbot, and lately even the fry of the sardine, leave the open sea for the lagoons of brackish water along the coast of the Mediterranean, the Adriatic, and the Atlantic. Is not this fact the very principle and basis of the dams, *valli*, fishponds and fish-marshes of Comacchio, Arcachon, and Sables-d'Olonne? Does not fresh water attract fry as powerfully as do current? All migrations of edible fish tend towards the shore, the confines of land and sea. And as a regular and constant migration is the primordial condition of industrial fishery, it is upon the confines of land and sea, upon the continental plateau, that our fishing-grounds are concentrated.

Such a coincidence gives us food for reflection. What is the meaning of this localisation of our fishing-grounds upon the confines of land and sea, that is, of two different elements?

If we pass these fishing-grounds in review,[†] we find that each constitutes a fairly heterogeneous environment, but the principal characteristics are found in all. The Atlanto-Saharan banks receive warm water, tepid water, and cold water. The banks of Newfoundland are an estuary formation still in process of deposition. They are swept by the warm waters of the Gulf Stream and the cold waters

[†] See Chapters II. and III. for details.

of the Polar current and the Cabot current. The Iceland banks surrounding the summits of the submarine mountains are fed with the warm waters of the Gulf Stream and the cold waters of the Polar current. The Wyville Thomson ridge first divides and then mingles the warm and cold currents, and to this mixture is due the wealth of the North Sea shoals. The Atlantic continental plateau is watered by warm and by luke-warm waters. The Channel and the Mediterranean undergo great fluctuations of superficial temperature in the course of the year. We must not forget that nearly all these banks receive the fresh water of rivers also: the Dogger, the water of the German rivers; the Bay of Calvados, the water of the Seine; while the other grounds are affected by the Loire, the Gironde, the Rhone, the Po, &c. Let us not overlook the bays, estuaries, creeks, lagoons (so rich in fish), and fishponds—those homes of fry, where the water is by turns warm and cold, and always brackish. Are fishing-grounds reported out at sea, on the very verge of the continental plateau? If so, you will find that in their immediate neighbourhood there are vertical currents, whether in the Atlantic or the Mediterranean; currents which bring cold water to the surface. You will also find a clashing of warm and cold currents, such accidents as the encounter or separation of currents. Everywhere you will find water in movement, but not in violent movement; everywhere water which is disturbed, water whose physical qualities are changing; everywhere a state of unstable equilibrium, of continual crisis. In a word, fishing-grounds are *regions in unstable equilibrium and in a state of crisis*.¹

¹ The expression "fishing-ground" is here used in its widest acceptation; that is, as meaning any locality where large quantities of fish are caught, whether on the surface or on the bottom.

This is the idea which irresistibly issues from these data. But the definition of a fishing-ground thus formulated is unilateral. It refers to the physical but not to the biological factors. We must now include the latter; we must consider how the fish behave upon the fishing-grounds; that is, if we wish our definition to assume the value of a law.

It is of course understood that the edible species never leave the immediate neighbourhood of the continental plateau; and we know that at spawning time they assemble in closely packed phalanxes and draw near to the shore. M. Cligny has shown that after spawning the shoals of herring disperse, without leaving the waters in which they have just been manœuvring, and that isolated individuals, still extremely voracious, travel between two waters, and are thus inaccessible to all the usual tackle of the fisherman. It is no less certain that the fry make for the coast, wherever they may be hatched. Very young flat-fish are found exclusively near the shore. As they grow up they scatter a little from the shore, but they return to spawn. In the month of April the sword-fish rise to the surface and steer for the Calabrian coast; there, changing their route, and now in couples, they spawn along the Sicilian coasts. In the Mediterranean the fry of the sardine, known as *poutina*, is taken at Nice a few fathoms from the beach. Thus the critical phases in the life of the fish—spawning, birth, growth, “fattening”—occur near the coast. Spawning is a complicated action which reacts upon every organ of the animal. Many fish change their colour and appearance at this time. The males in some cases develop a crest. The *Cottus scorpius* and the tetrodonta secrete poison. The salmon become quarrelsome and thin, and, like the sardines, “go off their feed.” These are sure signs of a

pathological condition. "The activity of the herring family," says M. Mader, "is considerably diminished : it may be a negative quantity, in spite of extremely satisfactory conditions ; moreover, the aspect of the muscular masses is not precisely the same as when the spawning is completed ; they seem to be more fragmentary. The circulation is concentrated upon the sexual glands, to the detriment of the other organs, which appear pale and degenerate." Whiting are fatigued ; their flesh is soft and the flavour unpleasant. Mackerel are thin and exhausted. Herring are also thinner, and solitary, and go in search of food. Their facial aspect is so changed at this period that for a long time they were described as "herring with a black-pointed snout," a special race, which was caught in February between Havre and Honfleur. As a matter of fact, these herring are simply thinner than the rest.

All these facts go to show the importance, among fish, of the crisis of sexual maturity ; among the adults as they spawn, the larvæ as they develop, grow, and often pass through metamorphoses, like the ammocœtes, which become transformed into the small lampern or sand-piper, the leptocephali, which become conger,¹ and the soles, plaice, and dabs, which become flattened from right to left ; and of the genital crisis among fry, when the male or female glands begin to appear.

Unstable equilibrium : a condition of crisis : let us repeat these two terms, which characterise the physical nature of the fishing-grounds. To the biological crisis is added the littoral oceanic crisis ; and fishing-grounds are *regions in unstable equilibrium, when there is an*

¹ Günther described the leptocephali as the larvæ of various fishes which had suffered an arrested development and never reached maturity.—[TRANS.]

encounter of two critical conditions, one biological and the other oceanic. When the French briar—the giant white heather—blossoms only at the end of the stems, the winter will be mild, and the spring will bring few sardines to the Breton coast; but when the briar is covered with bloom the winter will be severe, and the sardines will be plentiful in spring.

To explain the correlation I have just been expressing is a difficult matter, and at present, no doubt, impossible. Certainly the unstable equilibrium of the fish agrees very well with its actual independence. We may obviously maintain that a fish for which the maximum temperature is 60° will prefer to waters constantly at that temperature waters which attain their temperature on the spot, deriving from two currents, one at 59° and one at 61° , or one at 55° and the other at 65° , and so forth. It is probable that there is a sympathetic affinity between the critical state of biology and the critical state of oceanography: but this is a matter of metaphysics. I will adhere rather to positive observations. By definition, the critical state is a morphogenic state. As a matter of fact, it is at the surface and near the coasts that the oceanic circulation is most perceptible; and the circulation and agitation of the waters, and their fluctuations of temperature, are important factors in the modelling of the coasts and the shaping of new formations; for instance, recall the Newfoundland banks. These factors also result in an abundance of food, and, a little further out to sea, in an abundance of plankton. Remember the miraculous catches in the estuary of the Elbe. These conditions are also indispensable to the life of fry, to their growth and metamorphosis, and to the fattening of fish. The idea that the abysses of the oceanic world saw the origin

of marine life is no longer tenable ; the recent oceanographic expeditions have exploded it for ever. The womb of the ocean is the continental plateau ; the place of acute and constant crises, the place where even inorganic matter is not over-stable, while the floor of the gulfs is rarely covered with anything but clay, the last term of the mineral series. The creatures which people the abysses are emigrant forms, driven from the upper waters by the struggle for life ; they are the conquered. They appear to live upon the bottom, grouped in oases of some sort, in the desert darkness.¹ Is it rash to suppose that these oases are due to states of crisis, strictly localised and extremely feeble. The future will tell us . . . Venus Aphrodite, daughter of the sea-foam, was born upon the shore.

V

Natural laws are always narrowly limited in their bearing. They are provisional though convenient formulæ ; threads of Ariadne, which allow the seeker to find his way through the labyrinth of phenomena. If they have taught the technician a few certain methods, they have fulfilled their office. Our theory of fisheries is perhaps in a like case.

By means of this theory, I think, we can, without too great a probability of error, discover new fishing-grounds. Take a thermometer, a good chart of currents, and an ocean chart ; in an emergency the

¹ No light whatever reaches these depths, and most of the fishes which inhabit them are possessed of phosphorescent organs. It must be remembered that not only is the light absorbed by the water in geometrical progression, but that only light incident at a certain minimum angle can pierce the surface. From below, the surface of a calm sea is seen as a black, trembling sheet, metallic in appearance, with a great greenish circle of light overhead.—[TRANS.]

charts alone will suffice, and you need not leave your study. Wherever you find a zone in which warm and cold waters mingle, it is ninety-nine to one that you have hit upon a rich fishing-ground: a stretch of sandy bottom, with here and there rocks and valleys for the deep-water fish and shallower waters for the rest.

We may also expatiate upon the destiny of our present fishing-grounds. We have only to remember that local fluctuations are the result of phenomena which involve the general economy of the whole globe. The physiology of the Atlantic, and consequently that of the Mediterranean, the Channel, and the North Sea, depends, as we have said, upon the Gulf Stream. Now, the existence of so formidable a current as the Gulf Stream is related to the rotation of the earth. Plankton, that inexhaustible reservoir of nourishment, is inevitable, and as a whole constant. Its relations to the world of fish are also constant. Thus the alimentary problem is being constantly solved in the heart of the ocean, and the sea produces neither more nor less than it can produce. Fish, on the other hand, confined to the continental plateau and subjected to hereditary instincts, voracious and short-sighted, always hampered by their colossal numbers (banks of menhaden, the American herring, have been seen containing each more than 150 millions of tons of fish!)—fish, I say, are enclosed in a definite net of circumstance; they are accessible, and their capture is easy. Consequently, failing some world-shaking cataclysm, the existence of fishing-grounds is assured.

These are the results of observation; now let us pass to the results of experience. We shall find that the one class of results verifies the other. The Fishery Board of

Scotland formerly made reservations in the Firth of Forth, St. Andrew's Bay, Moray Firth, and the Firth of Clyde: for twelve years (1884-96) a little steamer, the *Garland*, was instructed to trawl there as often as possible. During the first five years the labours of the *Garland* showed a notable increase of fish; but this was followed by a no less notable decrease during the second half of the period. Statistics to hand, Mr. Macintosh has indubitably established the fact that the catches of a trawl on the same ground cannot be compared from year to year; that the years of large yields correspond with a larger number of hauls during the summer, the most favourable season; that the differences shown are of the category of habitual fluctuations in the yield of the products of the sea.¹ He finally asserts that the yield of fish will continually increase with the increase of fishermen, the improvement of gear and methods, and the conquest of fresh areas of the sea. The general depopulation of the seas is a myth. This I need no longer insist upon; but I will illustrate it by a particularly striking fact, a veritable experiment of Nature's. Upon

¹ I have designedly chosen two very different methods of fishery for the cod in which the professional skill of the fisherman plays an unequal part.

Years.	PAIMPOL SMACKS (LINE FISHERY).		BOULOGNE TRAWLERS (OTTER-TRAWL).		
	Number of Fishermen.	Tons of Cod.	Number of Trawlers.	Barrels.	Number of Cod.
1901	925	4,295	—	—	—
1902	1,030	4,049	—	—	—
1903	914	3,108	4	915	74,610
1904	1,218	4,548	10	2,584	60,190
1905	1,282	3,154	6	1,679	39,400
1906	1,387	3,859	10	5,154	330,845

the shoals of Nantucket, living among the codfish, is a species known as *Lopholatilus chamaeleonticeps*. In 1878 a sudden frost killed nearly all these fish. An area of 7,800 square miles of sea was covered with hundreds of millions of their dead bodies. From 1878 to 1882 no *lopholatilus* was seen. Between 1883 and 1893 a few specimens, gradually becoming more and more numerous, reappeared in the bays. To-day the repopulation of these banks by this species is complete.

Not only are the resources of man negligible as compared with those of the sea, but as the tastes and habits of consumers are not everywhere the same, the same fish are not caught everywhere in the same proportions. It is therefore certain that in many regions there are virgin grounds teeming with fish.

The Icelanders do not eat herrings. The herring fishery along the coast of Iceland was always negligible, and when in 1900 Consul Falck, of Stavanger, sent two small steamers, with nets of the Dutch type, to Leydisfjord, the catches were extraordinary—536 barrels in a few weeks. In 1902 Norway fitted out twenty vessels, which at the end of scarcely a month brought back 5,000 barrels. In 1903 40,000 barrels were taken; in 1904, 85,000; in 1905, 120,000. The Danes, Germans, and Swedes have followed the example of the Norwegians. Now the fishery is regularly organised; it is followed from the first days of July until the middle of September. I cite these details, and the following, from M. Cligny. From the earliest times the islanders and foreigners fished solely for the cod, and with the line. It is only quite recently that the trawlers of Grimsby and Aberdeen have used the trawl on these virgin grounds. "It is difficult to describe the prodigious catches of the first

voyages, the enormous plaice, the gigantic flounders, the myriads of cod, haddock, coalfish, ling, &c. ; fish which were then, and are still, brought back gutted and preserved in ice. Yet just lately a change has been observed in the products of the fishery, as always happens after a few seasons on virgin grounds. The enormous specimens which had peacefully grown old have disappeared, and the size of the fish caught has perceptibly diminished while the quality has improved ; the fish, however, are still so abundant that a vessel can bring away, after three weeks' fishing, the voyage there and back included, as much as 70 tons *net* of fish. . . . About 150 English steam trawlers fish regularly on the Iceland banks, registered mostly in Aberdeen, where they land their fish. A number of German trawlers fish on the same grounds and ply from the same port."

The inevitable day will come when the first reserves will be exhausted by intensive trawling—and I speak more especially of bottom fish, of flat-fish. Then will follow a state of equilibrium between the fishers and the reproduction of the fish ; that is, a period of constant fertility. Then, as in the North Sea, there will be a decline. But as methods become perfected, as vessels become large and costly, the shipowner will soon abandon exhausted grounds ; and as the demand for fish in the market does not decrease, and as hundreds of thousands of men earn their living by fishery, unavoidable economic necessities will send the fishermen, almost in spite of themselves, to new grounds, and so, by a just compensation, will give the old an automatic protection. One bank will "re-make" itself while another is being exploited ; then the latter will be given a rest while the fishing of the first is resumed ; and so on.

But the chopping and changing which this system will demand will only be possible to large steam trawlers, safe, well equipped, speedy, and backed by plenty of capital. Such methods are impossible to the small fishermen whose daily work is in territorial waters, within sight of the native steeple. Deprived of means and resources, attached by routine and poverty to the patch of ocean where their fathers have laboured, to the same boats, the same tackle, these unhappy men destroy far more than they produce. "Far from imitating the English fishermen, who know how to place their personal experience at the service of the general welfare, they are distinguished by mutual distrust." This phrase, quoted from the report of a French consul, was applied to the fishermen of the Baltic, not to the French ; but one might only too well suppose that the latter were referred to ! When the sardine is rare on the Breton coast, it is far simpler to seek it a few miles out to sea than to stay at home in the village and complain of starvation. God helps him who helps himself ! All the tunny fishers and many sailors assert that when the sardines desert the coast they are abundant in the sea. Let the fishermen go out after them, with suitable boats and gear ! The small German fishermen of the Baltic, behind whose backs I have criticised the French, now pursue the choice species which have deserted them far into the open sea. In the neighbourhood of Arcachon, as the result of the motor-boat fishery, a host of sardine factories have sprung up on the coast. In short, the depopulation of territorial waters is the result of small means, of poverty-stricken methods ; and the cause of the evil is technical and financial—in a word, social. Yet, as it is prudent, in dealing with the people of the coast, to take account of their spirit of routine, we must,

while waiting for the economic transformations which will select the best of them, make a radical application of the protective measures which I have explained in the preceding chapters, and which apply, as I have already stated, to fry and young fish. As for herring, cod, mackerel, sardines, sprats, and whiting, take them when and where they may be found; but give soles, turbot, and brill the time to grow. They will never go far from the shore; you can always find them again.

Modern fishery, to obtain a copious and regular yield, should be rapid and adaptable. It is in its power to be so. The fisherman of to-morrow will undoubtedly practise economy of effort, and will be rather an industrial artisan than a sailor; like a miner, armed with powerful tackle and implements, he will exploit that enormous mine, the fishing-grounds of the ocean. And while the *artisan fishers* plough distant seas, who knows but that some of them will not return to the coast, attracted by the easy methods of the dam and the fishpond? It would be folly to wish to empty all our fishing-grounds into fishponds, however perfect; Newfoundland and Iceland will always be Iceland and Newfoundland; and all coasts do not lend themselves to the construction of such devices. But—do not let us forget it—fishponds present in miniature all the conditions requisite to fishery. They are centres at once of conservation and production, made by man, subject to his will, and therefore capable of infinite improvement. Hence the artisan fisher will be comparable now to a miner, now to a farmer. But the oceanic mine is inexhaustible! And the fishponds are fields which no one tills nor sows, and which, for an equal area, give a profit three times as great as arable land!

It seems to me that past and present agree in justifying this glimpse of the time to come. But I am loth to utter facile prophecies, for I do not wish to be carried away by my imagination and write, in the guise of science, a useless and deceptive romance.

PART II
PRODUCTION

CHAPTER I

SOCIAL LIFE ON THE COAST

- I. The *οἰκουμένη* of the coast—Antagonism between fishing ports and commercial ports—Historical pen view of the development of the Havre district. II. Principal professional and social groupings among the French fishermen—The necessity of an extension of the *œcumene*.

WE can understand any particular phenomenon only if we know its genesis and relate it to a general phenomenon. This necessity is, perhaps, more than usually pressing in the case of fisheries, for, like an ancient tree, they have roots longer and stronger than the trunk itself.

I

As a result of the recent works of MM. Marcel Dubois, Ratzel, Ritter, Vidal de la Blache, Vallaux, and Demangeon—to cite no more—social geography has entered upon a new phase; and from the maritime point of view, which alone concerns us here, the notion of the *œcumene* has been of the greatest service. "There is no *œcumene*," says M. Vallaux, "save when there is the confinement of a determined social aggregate in a particular geographical region, comprising, say, the edge of a coast with the continental plateau, which serves it as base, or a border of coast with a secondary sea (surrounding or surrounded by land, or an island sea), or an island or large group of islands, or a fishing-ground where many vessels meet in

rendezvous. In a word, there is no maritime œcumene unless there is a prolonged or habitual stay in a geographical framework of coasts and waters." The Breton coast is a perfect type of maritime œcumene. Cut into creeks and bays and estuaries, resting on the continental plateau, rich in edible species, it holds the individual as in a vice, and offers him nothing but fishing, the small coasting trade, or isolation. The Baltic is not a similar region; from one end to the other communication is constant. The North Sea is only a vast prairie where the trawl replaces the plough. A hundred and thirty thousand sailors live there every year, and if we count the men who live by dependent and allied industries (including shipbuilding, net-making, smoking and salting houses), we reach a total of 400,000. This great population of fishermen transports its daily life, its habits, and its manners to the Dogger and the Fisher Banks. Special boats—the "coopers" and "bumboats"—go from trawler to trawler, selling drink and tobacco.

In the North Sea the œcumene of the coast is the concern of the fishermen. As for commercial ports, they are concentrated on the west and south coasts of Great Britain—Glasgow, Liverpool, Bristol, Southampton, London; or at the mouths of the continental rivers—Hamburg, Bremen, Rotterdam, Antwerp. The commercial and fishing ports seem to be separately distributed. In Brittany the little fishing ports swarm on the coast, but there is not a single great commercial port. Boulogne is the most important fish-market in France; otherwise, it is a mere ferry station. Dieppe is not unlike Boulogne. Fécamp equips none but herring boats and cod boats; Arcachon, trawlers and sardine boats; La Rochelle, the ancient stronghold and trading port, draws its principal profits from trawling, leaving the ocean-going vessels to

La Pallice. Fishing ports, in short, have become specialised ; and their positions are determined by the immediate neighbourhood of the continental plateau, where fishing is easiest and most fruitful. This is so true that Grimsby, destined since its origin to be a coaling station, has become by force of circumstances, and despite the considerable advance of Hull, a great fishing port—the greatest in the world ; moreover, both the Dutch and Germans have succeeded in building two completely equipped and prosperous fishing ports not far from Amsterdam and Bremen : Ijmuiden and Geestmünde.

These general ideas will be found more clearly and precisely exemplified in the history of the Havre district.

Having massacred or dispersed the prehistoric races, the Gaulish tribes of the Caux or Calètes country built, on the right bank of the Seine estuary, three fortified villages, to protect themselves against pirates and to shelter their fishing boats. Three towns thus originated : Lillebonne (Juliobona) up-stream, Ingouville down-stream, and Harfleur (Caracotinum) between the two ; and these, under the Roman rule, were fully equipped and maintained centres of warfare between Lutetia and England. However, the sea retired from Ingouville and Lillebonne, leaving marshes interspersed with creeks. The fishers of Ingouville then emigrated towards Cap de la Hève, and there laid the foundation of a seaside village : Saint-Denis Chef de Caux. At the same time the commercial development of Harfleur drove the fishing boats towards the creek of the Leure, near the creeks of Ingouville.

In short, at the end of the tenth century there was one great commercial port—Harfleur—and two small fishing ports : Chef de Caux and Leure. Thanks to the traffic in Spanish wines, Chef de Caux quickly became a serious

rival to Harfleur, but in 1374 it was overwhelmed by the sea. Attempts to rebuild it were vain : it vegetated until the fifteenth century and degenerated into a poor fishing village. The fate of Leure was happier ; the mackerel and herring fisheries prospered, and to these industries the inhabitants added that of salt-making. About 1364 its prosperity was suddenly increased by the silting up of the port of Harfleur, to which it succeeded as a commercial port. As a result, the majority of the fishermen of Leure removed their boats to the largest of the creeks of Ingouville, known as the Crique de Grâce. As for Harfleur, ruined by the English and obstructed by alluvial deposits, it disappeared from the seafaring world at the end of the fifteenth century. Only one commercial port was left—Leure—and two fishing ports of unequal importance, the Crique de Grâce and the Chef de Caux.

Leure was flourishing, but had one grave defect : it was not fortified. Louis XII. thought of transforming it into a military port ; Francis I. did so transform it. Following the advice of Admiral Bonnivet and M. du Chillou, he selected the Crique de Grâce, which became the nucleus of the city of Havre. As the position of the "French City" was excellent, it quickly attracted all the trade of the surrounding country, and Leure was soon absorbed by its powerful neighbour. Havre was now a stronghold and a trading port. It is probable that the small fishermen remained at Leure, for on January 15, 1527, a tempest, referred to by the chroniclers as the "evil tide," hurled into the moats of the Château de Gravelle, which lay below Havre, twenty-eight large herring and mackerel boats. I say "small fishermen" in order to distinguish them from their fellows the ocean-going fishermen. These latter have their origin in the

"French City," which, in 1536, first of all French ports, fitted out a vessel named the *Catherine* for the Newfoundland banks, and later on sent out three-masted whaling vessels. In the course of the sixteenth and seventeenth centuries numbers of Newfoundlanders sailed from Havre every spring; then the commercial extension of the port drove them to Fécamp, and the whaling fishery was abandoned. To-day Havre is exclusively a commercial port. Except in winter, when it exports herring, the products of the local fishery are consumed by the city. While the new docks were being built on the ancient site of Leure, the fishing boats took refuge in the ancient Crique de Grâce, now converted into a dock; and since the construction of the two great breakwaters the small fishers of Chef de Caux, now Sainte-Adresse, have landed their fish in the outer harbour.

II

It would seem that there is an antagonism between the commercial port, which is a port of circulation, and a fishing port, which is a headquarters port; that is a consequence of the œcumene. In considering the œcumene more closely in the course of this work, I shall often have occasion to make the same remark.

The men of Roscoff do little fishing; they are occupied principally in transporting onions, artichokes, and potatoes of their own cultivation to England. In the island of Java and in parts of Borneo and Sumatra, writes M. Vallaux, "the towns and villages are conspicuously gathered at the mouths of the rivers which provide them with convenient harbours. The towns are obviously before all centres of trade, but the villages are inhabited by fishermen, and this method of grouping has lent to the Malay or Chinese vessels their generic names: they

are *balangay* and *sampans*." Along the hot coasts, where fish quickly putrefies, the sea-board oecumene is commercial. Sardine Bay, "Ancon de las Sardinias," on the coast of Ecuador, which is swarming with fish owing to the cool waters of the Humboldt current, is unexploited. The coast waters of Venezuela are rich in edible species, but there are no fisheries there. On the other hand, certain natives of Celebes, the *Orang-Badjo*, are unfitted for any employment other than fishing, and pass their entire lives in their boats. These "sea-gipsies," living on board their primitive praus, are continually wandering along the bays and promontories. The fishers of the Philippines are a little higher in the social scale ; during the north-eastern monsoon they work the south-western coast, and change their ground when the wind changes.

Let us go further up the ladder. The inhabitants of such islands as Groix, Sein, the Lofodens, the Orkneys, and the Shetlands have no occupation but fishery. For three centuries, from 1500 to 1825, Newfoundland remained unexplored ; all the life of the island was on the coast. To-day one quarter of the islanders (52,500 out of 202,000) are occupied in catching and salting cod, and the interests of most of the rest depend indirectly upon the fisheries. In Nova Scotia the land is not cultivated ; in Norway the face of the mountainous coast is peopled with fishers. There, as in Newfoundland, the social organism is restricted to the professional group. Man is scarce and the fishing-grounds enormous, so that there is no coalescence of social groups. There are no villages : each fisherman inhabits an isolated house ; collectivity does not extend beyond the family. The solitary fishing vessel corresponds with the solitary house, the Norwegian *gaard*, painted with bright, crude colours—yellow,

green, red—as though the better to attest the incontestable proprietorship of the occupant.

To the flotilla of boats fishing in common corresponds the Breton or Cornish fishing village. Men are plentiful, the fishing-ground is limited.¹ They must therefore gather together to defend themselves against foreigners. Foreigners are men of the nearest village, and villages swarm along the Breton coast. We know what a fishing village is in Brittany. At Douarnenez the houses are huddled against one another : the alleys are winding and narrow. The fishing quarter of Boulogne has the same appearance. If Fécamp is different it is because the majority of the Newfoundland fishers live in the suburbs : Senneville, Criquebœuf, &c. Crowded populations depend always on the size, fertility, and distance of the fishing-grounds. Grimsby and Aberdeen are cities of artisans. Saint-Pierre, the port of the island of that name, is the central station of the French cod-fishery. Thus the more extensive the œcumene, the greater the concentration of the fishermen. The men of the coast lag behind those of the interior, but they follow the same path : from the garret or shed to the workshop, and from the workshop to the factory.

Groups of economic and professional origin fashion the spirit of the race. The Norwegians, who are individualists, furnish the school of Le Play with its strongest arguments as to the social importance of the family. The Bretons, who are particularists, are brought up in a parochial atmosphere—like the Norwegians, they handle both the oar and the sickle ; there is nearly always a little field of oats or barley near the fisherman's cottage.

¹ In St. Ives Bay the lights of eighty to a hundred and twenty "drifters" may be seen on a calm night, all within the shelter of Godrevy reef.—[TRANS.]

The sardine fishers of Arcachon are "casual" fishers, whose hands have been more familiar with the oyster-beds or the vineyards than with the net or the oar. But who knows that it is not on account of their professional youth, so to speak, to their freedom from tradition, that they immediately adopted the motor-boat? There are large villages lost in Limousin, Quercy, and the Landes which yesterday knew no illumination but the candle, yet to-day are lit by electricity.

To sum up: the great majority of our fishermen are of the purely maritime type; and in spite of recent strikes on board some of the trawlers of Lorient and La Rochelle, the French fisherman is not yet an artisan.

By this I mean that the French owner of fishing vessels is not often a capitalist. Certainly there are French owners who own large numbers of vessels—as at Boulogne—and there are important trawling companies in France, as at Arcachon; but how many master-fishermen own their own vessels? How many owners are there, only too often, to one boat? In France the capitalist control of the fisheries is as yet in its infancy. When new fishing-grounds have been conquered and methods have been improved; when machinery is more widely used and the by-products of fish, such as oil and glue, are more widely utilised, the seaboard œcumene will break its primitive bounds and take its rightful position in the world.

CHAPTER II

FISHING PORTS

- I. Generalities concerning the French fishing ports. II. Boulogne, Fécamp, Arcachon; Grimsby — Description of these ports; their equipment and their physiognomy. III. Hull, Yarmouth, Lowestoft, Aberdeen — Description of these ports — Esbjerg, Geestmünde — History of the latter: its organisation — Cuxhaven, Ijmuiden. IV. The French, English, and German administrative systems. V. Conclusion.

THE reader will have seen that a summary consideration of the œcumene has led me to the same conclusion as the general theory of fisheries; it is the same fact translated into two different tongues; and we shall frequently encounter it in this the second portion of this book.

I

The sea must be ordinarily very rough, the currents unusually dangerous, and the coast remarkably inhospitable, if the traveller fails to perceive, along the shore, the modest fishing boat sheltered in some little cove, or hauled up upon the beach. There are fishing ports wherever Nature will permit them; but the majority are the ready-made havens in which our prehistoric ancestors made themselves at home. Between the primitive port and the modern port are all imaginable stages. Consider Étretat in the Channel and Saint-Laurent de la Salanque

in the Mediterranean—mere naked beaches, on which the boatmen haul up their heavy boats, as do the Norwegians on the portages at the head of their fjords. Consider Gujan-Mestras, in the basin of Arcachon; there the fishermen themselves have made a tiny harbour of wood and beaten earth in the shelter of a stone jetty. Douarnenez has a long, wide breakwater; Camaret, a dock; Arcachon, iron piers; Fécamp and Boulogne have spacious inner harbours, docks, tidal gates, and graving slips.

In England fishing is centralised in *a small number of large ports*; in France it is dispersed over *a large number of small ports*. England has Grimsby and France Boulogne. In 1905—the best year it has ever known—Boulogne gained from its fisheries a profit of nearly £900,000, while the leading British port netted over £2,400,000. This difference, great as it is, would be a matter of little importance if the curve of production of the French fishing ports were regular. But this curve is anything but regular; at the very outset it falls abruptly to the neighbourhood of the abscissæ, and continues almost in a straight line. Fécamp follows Boulogne at a very great distance; Arcachon comes shortly afterwards. Past Arcachon we find a lamentable monotony, the obvious result of the dispersion of effort. If in place of considering the total tonnage we consider the tonnage of steam trawlers only, we shall find the fall is still more abrupt. Boulogne is still first with 21,112 tons; Arcachon comes second with 8,617 tons; La Rochelle third with 4,468 tons. Then follows a dreary list: Dieppe, Lorient, Fécamp, Gravelines, Saint-Jean de Luz, Croisic, Tréport, Calais, Havre, Caen, &c. Nevertheless, certain ports—Lorient and Havre, to mention only two—are making praiseworthy efforts. Ask a tourist who has

visited the coasts of England and Scotland, Holland and Prussia, for his impressions; he will reply, "Compared to the magnificent fishing ports which I have seen, the French ports are very indifferent and ill-equipped." This is only too true. For what is a French fishing port?—a harbour, a basin, often open to the tides, with bare quays and a single fish market, more or less convenient, and that is all. We shall see what care has been expended in equipping the port of Geestmünde. The contrast is striking. We should seek in vain for anything of the kind on the French coast, which has no port specially constructed for modern fishery. It is not that the State is indifferent to the question; but the works which it has undertaken after many years of study, inquiries, counter-inquiries, and innumerable and ponderous reports, it has frittered away here, there, and everywhere, instead of concentrating them in three or four already prosperous ports.^{*} In this connection I have been told that some pessimistic spirits profess that electoral politics, in order to gain the faithful support of our sailors and fishermen, is doing very ill service to the national fishing industry and the national carrying trade.

The fishermen of Boulogne undertake all branches of fishery. From April to October they take the Scotch herring and the herring of the south-eastern coast of England. Their nets are scarcely dry when they set out in pursuit of the banks of winter herring in the Channel—a fishery which lasts into December. From April to July they pursue the mixed cod and herring fishery to the north and east of England. All the year they trawl

^{*} The scheme for rebuilding the port of Concarneau (which is now only waiting for the ministerial signature) has awakened the keenest controversy among the seafaring population of the port, which, in general, does not approve of it.

in the North Sea, the Channel, on the Atlantic continental plateau, and along the Spanish and Portuguese coasts. In March, April, and May they catch the Irish mackerel, which they salt on board, and in June the Channel mackerel. From Newfoundland they bring cod; from Iceland cod and herring. I say nothing of the coast fisheries, with the line or with nets, nor the shrimp and mussel fisheries. Fécamp fits out its vessels for Newfoundland and the Dogger; it also sends out a number of herring boats. Dieppe is concerned principally in mixed fishery in the Channel; Saint-Malo, Granville, Saint-Servan, Cancale, and Bayonne send vessels to Newfoundland; Dunkirk, Gravelines, Paimpol, Saint-Brieuc, and Binic to Iceland. Arcachon and Lorient engage in the Newfoundland fishery and in trawling over the entire continental plateau, where their steamers meet those of La Rochelle. In the summer the fishermen of Groix pursue the tunny; in the winter they trawl. All the small fishermen of the Atlantic coast catch sardines, from Camaret to Hendaye, including Douarnenez, Concarneau, Étel, Sables-d'Olonne, and Gujan-Mestras. In the winter they catch flat-fish and other bottom fish. In the Mediterranean Collioure, Port-Vendres, Saint-Laurent de la Salanque, Cette, Marseilles, and Nice engage only in the coast fishery, catching sardine and anchovy.*

* The principal French fishing ports are : Dunkirk, Gravelines, Calais, *Boulogne*, Tréport, Saint-Valéry, *Dieppe*, *Fécamp*, Étretat, Havre, Honfleur, Trouville, Caen, Port-en-Bessin, Cherbourg, Granville, Cancale, *Saint-Malo*, Saint-Servan, Saint-Brieuc, Binic, *Paimpol*, Douarnenez, Camaret, Audierne, Quimper, Concarneau, Étel, *Lorient*, *Groix*, Auray, Belle-Isle, Noirmoutiers, Croisic, Nantes, *Sables-d'Olonne*, *Rochele*, Ile de Ré, Ile d'Oléron, Rochefort, Marennes, *Arcachon*, Gujan-Mestras, Bayonne, Port-Vendres, Saint-Laurent de la Salanque, *Cette*, Les Martigues, *Marseilles*, Toulon, Antibes, Nice, Ajaccio, Bonifacio.

II

Proceeding from these generalities, we must now consider the French fishing-ports more closely, and, by comparing them to those of our neighbours, consider what modifications of a technical or administrative category should be effected.

The port of Boulogne, situated in the estuary of the Liane, comprises an outer harbour and three docks. The first of these docks is a continuation of the entrance channel; it receives trawlers, herring boats, and the boats of line-fishers, who enter and land their fish there. The quay, which is on the side of the town, has only a very insufficient market, where the fish is sold by auction. The carriage of fish, ice, and coal is effected entirely by means of carts. The second dock, above the first, and fed partly by the waters of the Liane, is hardly used. The third communicates with the outer port by means of a lock; it is used by merchant vessels and by trawlers out of commission or in process of fitting out.

During the Newfoundland season the harbour of Fécamp is deserted. It recalls the harbour of Boulogne: an entrance channel, a large dock with gates and sluices, known as the Berigny basin, and to the right of the Berigny basin, receiving the waters of the river Valmont, a new outer harbour, a semi-tidal basin, and the "new basin," which is irregular in shape. At the moment of departure for the banks the vessels are crowded together anyhow; the whole harbour bristles with masts. At Boulogne and Fécamp there are building-slips in the outer harbour, and, at some distance from the quays, factories for salting, drying, smoking, &c.

It is useless to describe the rest of the French

harbours ; there would always be the same mention of quays and basins ; but I must briefly describe the arrangement of the port of Arcachon. It consists of jetties at right angles to the shore, running out towards the channel ; they are over 200 yards long. The trawlers can enter at any state of the tide. The wharves are provided with mechanical tractors on rails and electric cranes. They are backed by repairing shops and warehouses ; there is an ice factory with cold-storage chambers, a fish market, a preserving factory, a packing-case factory, and an auction. Between these buildings and the sea is a yard some 2,000 square yards in area, capable of storing 3,000 tons of coal ; and two powerful electric cranes, capable of handling 600 tons a day, speedily fill the bunkers of the trawlers. Each fisheries company has its own wharf. That which I have just described belongs to the New Steam Fisheries Company (*Société nouvelle des pêcheries à vapeur*). From the report communicated by M. Haentjens, director of the company, to the Congress of Bordeaux, I quote the following lines : " Directly a returning vessel reaches the entry of the Arcachon channels the semaphore on Cap Ferret advises the company by telegraph, and transmits the signals which make known the result of the voyage—Y. O., for example, meaning 6,000 cod. Immediately the fish market is cleared for action ; the wicker hampers for unloading the fish and the crates of coal are placed on trolleys, and the mechanical tractor of the moving gangway is set in motion to drag them to the pier. The boat is hardly hailed and the ropes attached to the hawsers thrown, when the unloading of the fish commences, while at the same time the coal is shot into the bunkers. In less than two hours the 6,000 cod, gurnards, gilt-heads, rays, and

soles, or about 15 tons of fish, are in the fish market, while the 60 tons of coal are in the bunkers. In another hour the vessel, having taken in 10, 15, or 20 tons of ice, according to the season, is ready to sail again, and the crew of ten men who have just performed these wonders are ready to begin work again the same evening. In two minutes the mechanical tractor of the travelling gangway transports a hamper of fish from the ice-box of the vessel to the fish market, whence its contents are despatched, according to its destination, to the auction, the refrigerating chambers, or the canning factory, or direct to the packing sheds."

Boulogne, Fécamp, and Arcachon are full of activity. At Grimsby, however, the activity is feverish. Although I was warned, I was absolutely stupefied by the extraordinary movement of this port. Watching the unloading every morning of the fish brought by a hundred steam trawlers, one seems to be in the land of demons. It is a swarming army of fishermen, porters, criers, dockers, and packers, and the uproar is truly infernal.

Grimsby is the first fishing port¹ of the world. It owns nearly six hundred steam trawlers and only thirty sailing trawlers. The fishing harbour or "Fish Dock" is distinct from the trading harbour. It comprises two entrance channels, with tide-gates, a first basin of 12

¹ The principal European fishing ports are Grimsby, Hull, Yarmouth, Lowestoft, Scarborough, Whitby, North Shields, Ramsgate, Boston, Sunderland, and Hartlepool, in England; Aberdeen, Peterhead, Fraserburg, Leith, Buckie, Wick, Macduff, and Montrose, in Scotland; Lerwick, in the Shetlands; Geestmünde, Nordenham, Cuxhaven, and Altona, in Germany; Esbjerg, in Denmark; Stavanger, Bergen, Aalesund, Kristiansund, and Tromsø, in Norway; Ijmuiden, in Holland; Ostend, in Belgium; Setubal in Portugal; and Vigo, in Spain.

acres, an inner basin of 15 acres, and two dry-docks. The market is built on the quay; it is an enormous shed, no less than a mile and three-eighths in length, and is divided into two floors. Under this shed the fish is unloaded, sold, and packed. How much better this system is than the French system, which consists of carrying the fish to an often distant market! There is direct communication between the boats and the shed. On the further side of the shed are the railway lines. At the hour of despatch in the afternoon it is not unusual to see four trains being filled at the same time. All the equipment necessary to the fishing industry is concentrated in the Fish Dock, from the ice factories to the ship-chandlers' stores.

M. Roy has described, in picturesque terms, the inner life of Grimsby: "It is a curious spectacle, the sight of the fleet of trawlers ascending the Humber from a period two hours before flood tide, at which time the tidal gates are opened. As far as one can see the heavy, troubled waters are obscured by the smoking funnels of the boats as they hasten in, for the place which they will occupy along the pontoon is not without importance, as the sale begins at the northern extremity of the shed. Between the jetties, which are, perhaps, too close together, there is a hustling, a veritable scrimmage, of hurrying vessels, which are continually thrown against one another by colliding bows or beams; but there is never a serious collision, and it seems a miracle that there is not. The docks gradually become busy; the first arrivals tie up to the best places in the first basin; bows on to the quay, they arrange themselves in close-packed ranks. When the first dock is filled, the newcomers, in order to reach the second, have to make a sudden turn at the

apex of the triangle formed by the pontoons ; but they scarcely slacken speed, lest a less cautious skipper should pass his rivals. Faster and faster they arrive, urged on by the tide ; taking the corner at a lively speed, bumping vigorously on the solid wooden guards of the quay, and often heeling over a considerable angle ; but no harm is done ; if they collide they recoil from the shock, and the great thing is to be moored to the quay in good time. Unloading commences at once ; the baskets are hoisted from the hold loaded with fish ; there is a continual going and coming on the gangways thrown between the bows of the vessels and the quay. The codfish, all dead, with glassy eyes, are stretched out in lots of 12, 24, or 36 ; enormous halibut spread their white bellies, some, still shaken by convulsive shudderings, opening and shutting their huge mouths. The smaller species—whiting, plaice, gurnards, &c.—are carefully washed on the tables and arranged in wooden boxes, which are set in rows along the pavement, still impregnated with the smell of yesterday's catch, in spite of the washing it received last night. At eight o'clock the auction commences. At the northern extremity of the shed the official auctioneers bawl out the names of the fish they are offering for sale ; a boy vigorously rings a huge hand-bell, and the buyers approach. The buyers are everywhere, stamping to and fro in their heavy boots among the slimy fish ; each, as a lot is knocked down to him, replacing the seller's ticket by his own. Porters appear immediately and remove the fish as it is bought, trundling it along on barrows to the shed rented by the buyer within the market enclosure. Others have large warehouses connected with the market by flying gangways. Thus the sale goes from end to end of the quays, and all the morning and afternoon an army of

jostling labourers wash, scrub, and pack the fish, and load it on the railway trucks. From time to time a locomotive whistles : a train is made up and pulls out of the market." Sometimes men armed with long sharp knives go by almost at a run, working at the closely-packed rows of cod, plunging their knives into each fish, and snatching the livers from the slippery bodies.

The fish has now been sent in all directions : 700, 800, often 1,200 tons of fresh fish, occupying 200, 250, or 400 waggons. Meanwhile the trawlers, who will put to sea on the following tide, have lost no time ; they have filled the holds of their vessels with ice, the bunkers with coal, seen to their spare stores, and replenished their stock of victuals. The Grimsby Ice Factory, the chief concern of the kind in the port, is situated on the quay of the Fish Dock. It makes about 350 tons of ice every day. The trawlers are supplied with coal from hulks and lighters. Grimsby harbour, unfortunately, which was built by a Frenchman and is of comparatively recent construction, is already too small, and it is hardly possible to enlarge it, as it is built far out and in deep water.

III

I have given so much space to Grimsby that I must speak more briefly of the other principal ports.

Hull is less modern than Grimsby. The Fish Dock is a vast basin, divided into two unequal parts. The first and the larger receives the trawlers.* The market-shed occupies the whole of one side. It is much smaller than that of Grimsby, and is provided with only two lines of rails. The other side is devoted to coal stores and ice factories. The second portion of the basin is

* Of which there are nearly 450.

used for refitting and by vessels going out of commission, and contains careening slips. Hull exports cod and fresh fish, especially to London ; it is despatched to Billingsgate Market in carrier-boats ; but there is no herring fishery, as at Grimsby.

The most important centre of the herring fishery in England is Yarmouth-Lowestoft. Yarmouth Harbour, says M. Roy, "lies along the course of a river, the entrance of which is difficult, owing to powerful currents ; there are two wooden jetties, with a sharp turn between them. Cargoes of herring are landed at some distance from the pretty little town, and are prepared in factories situated between the river and the beach. All herring are landed in the market and measured by narrow two-handled wicker basket-measures, of which two make a "cran," the legal measure. They are sold by auction, and carried to the factories in waggons. At Lowestoft they are sold as in the Shetlands : on the arrival of the boat a sample only of the cargo is sent to the market and sold by auction. The boat proceeds to discharge its cargo at the stall or warehouse rented by the buyer in the market itself."

Aberdeen, the largest fishing port in Scotland, possesses a basin nearly 15 acres in area, formed by the ancient bed of the river Dee, which has been diverted to the south. The basin is enclosed by wooden piers with paved quay-tops. Dredgers maintain a depth of from 10 feet to 14 feet 6 inches along the quays. The Fish Dock is accessible at any state of the tide. The whole of the northern and western quays is covered by an immense shed. Here every morning the trawlers and line-fishers haul alongside ; here, too, is held a special market for salmon, which are caught along the coast in stake-nets. The fish chiefly exported is the haddock ; it is divided

into heaps of five to ten fish. Cod, ling, halibut, and other fish of greater value are ranged in rows on the quay and sold in groups. The fish intended for preparation is taken in carts—the railway is not employed in Aberdeen—to the factories, where it is gutted, cleaned, and salted or smoked. Everyone knows the famous “finnan haddock” of Aberdeen. The landward portion of the southern quay is occupied by a floating dock. On the west of the quay and on the opposite portion of the northern quay, a space between the quay and the dry dock is nothing but barrels—pyramids of barrels; it is here that the drifters moor, bows on to the quay, and unload their cargoes of herring. There are often as many as 400 herring boats moored, with a whole population of fishermen, stevedores, packers, coopers and carters jostling round the vessels. Even in the middle of the summer—I myself was in Aberdeen in August—the animation is extraordinary. In that part of the city near the Fish Dock the signs on the houses are invariably the same: “Fish Merchant” or “Fish Curer.”

Here follows a brief description of four harbours recently built, all situated on the North Sea, and in many details unlike the English ports: Esbjerg in Denmark, Geestmünde and Cuxhaven in Germany, and Ijmuiden in Holland.

Esbjerg has two entrances, one to the commercial and one to the fishing port. There is no covered market. The fish is bought beforehand by a score of salesmen, who send it to Hamburg and Berlin. In the harbour are a number of huge floating cages in which the fishermen keep alive such fish as are not immediately sold. Unlike the English, the Germans do not care for chilled or frozen fish. Packing is done on the quay, and the cases are loaded direct on the trucks. Esbjerg

is noted especially for plaice and cod. The herring ports of Denmark are on the Baltic.

Geestmünde is a thing of yesterday. The estuary of the Geest, a small tributary of the Weser, used to shelter a few fishing-boats. The arrangements for selling their fish were so primitive that the fishermen themselves decided to demand a quay and wharfage from the commune of Geestmünde. The little port did well ; but as long ago as 1892 the Geest had become too small for the handling of the fishing-boats, and as the port of Bremerhaven had begun to excavate docks, the Prussian State decreed the establishment of a special fishing harbour, provided with a modern equipment. An enormous breakwater was built in the Weser, constructed of bays resting on the material resulting from the displacement of an arm of the Weser, so as to provide a foundation for the ulterior installation of the buildings of the new port. The area gained from the river was 180 acres. Such was the origin of the present Geestmünde. This port furnishes one example the more of the method and the power of work of the Germans. While the English and ourselves, entangled in a network of secular interests and traditions, are obliged to reckon with the past, our neighbours across the Rhine, like the Americans of the States, will at a single breath create new things and preside at the inauguration of the working of the new structure.

The fishing port of Geestmünde is accessible at any state of the tide. It consists of a very long and relatively narrow basin. By the side of the Weser, and backing on to the breakwater, stretches a large flat space on which the fish market is built, and behind this the factories and warehouses. The railway station is at the extreme end of the market. On the Bremerhaven side the quay is bare ;

but the engineers, with their habitual prevision, have reserved an immense space for projected enlargements. At the end of the basin are three dry docks, facing which are the coalyards and the ice factory. Nearly 200 boats, the majority of them steamboats, frequent the port. Their radius of action extends to Iceland and the White Sea as far as Morocco.

The unloading of the fish is effected with the help of the derricks on board and the electric cranes on the quay. "The fish-merchants," writes M. Hart, "assemble in the morning, and auctions commence under the direction of a sworn auctioneer, according to the order in which the fish have arrived, which is indicated by a notice-board. With the exception of herring, which are sold by the box, the fish come into the market weighed; oysters are sold by the hundred and lobsters by the piece." There are numerous preserving factories, two factories preparing fish farina, and three factories which prepare fish oil. An open belt of land has been left near the breakwater.

The modern fishing harbour of Cuxhaven is only three years old. It is built in the estuary of the Elbe between the Old Port, on the north, and the New Port, the commercial port, of the same city. It comprises an outer port, which opens through a breakwater, and a basin. The trawlers moor bows on against a quay of wooden piles, behind which is a market for the newly landed fish, a packing-hall, and a cold chamber, and finally a railway track. There are twenty reservoirs for fish in this harbour, each of about 1·8 cubic yards in capacity.

Ijmuiden, the principal fishing port of Holland, situated on the canal running from Amsterdam to the sea, consists of a single basin excavated to a depth of 19 feet below the low water of the charts, surrounded

by roomy quays, on which are the markets, warehouses and ice factories. It is intended to increase the length of the basin by 220 yards, and the depth by 6 feet 6 inches, and also to construct three other docks. Even in 1900 more than 11,000 tons of fish were sent by rail into Holland, Belgium, and Germany.

IV

The equipment of a port is not everything. The manner in which it is administered is also an element of success.

The French administrative system, from the Revolution to the present time, has passed through three phases. In the first place the ports kept their own budget, but it was administered from Paris. Then the Restoration completed the work of State centralisation and completely assimilated the ports to the highways. To-day those chiefly interested have acquired, together with the Chambers of Commerce, a fragmentary power over the working plant and equipment. In this capacity they can impose certain local rates, which destroy the fiscal uniformity of the tariffs imposed in the various ports, but give them very little real initiative, since these rates correspond with obligatory expenses. "No sort of financial order," writes M. d'Agout in his noteworthy report to the last Congress of Commercial Ports, "throws a light on these successive transformations, made without any general plan, under the stress of necessity. The confusion is maintained and even increased by the natural tendency of the administrations to retain jealously the initiative of schemes and works, while responsibilities are dispersed to the point of being intangible. There are no public bodies in the ports entrusted with such matters as their enlargement, or even their upkeep.

Five Ministers—those of the Marine, Public Works, the Interior, Finance, and Commerce—have the decisive word. Of all their needs, functions, and activities, only one is provided with a budget and administration of its own: the tools and implements necessary for upkeep and repairs.” This is incoherence raised to the dignity of a principle: it is unity in diversity. I seem to remember that “unity in diversity” was St. Thomas Aquinas’s definition of beauty! I am afraid the meaning of the phrase has changed a trifle since the Middle Ages.

The English formula would appear to be diametrically opposed to the French: diversity in unity. In England the organisation of the fishing harbours is the work of local councils or Harbour Boards, which, on condition of submitting the plans of the works they wish to carry out to the Board of Trade, receive grants in proportion to the importance of these works, in the general interests of the country. The greatest liberty is left to the local bodies. The latter transmit their demands to a district committee which corresponds directly with the Board of Trade. There are twelve districts. In Scotland the coast is divided into twenty-nine districts, placed under the direction of the Fishery Board of Scotland, which sends an annual report to the Under-Secretary of State for Scotland, and may make advances to the local bodies. The State grants are only made to ports already prosperous and never exceed the third part of the sum required, the remaining two-thirds being furnished by local taxation.* The local board at Grimsby is largely constituted of delegates of the Great Central Railway Company, and the whole harbour is really the property of the Company. It collects a due

* Very small harbours are in the hands of the town councils.

of 1d. per ton from trawlers and a due of 7s. 6d. from herring boats.

In Germany the fishing harbours are constructed at the expense of the States on whose territory they are situated. "The central authority intervenes only in the appointment of the superior officials of the Fisheries Service, who direct the exploitation of the ports on account of the interested States, so that the officials in supreme charge of the fishing harbours are always men who are expert in all the necessities of the fisheries, as well as the various methods of sale" (Hart). The harbour of Geestmünde is administered by a leasehold company, consisting of shipowners and fishermen, and approved by the Prussian State. It was formed on October 1, 1896, with a capital of £15,000. It imposes three kinds of dues : 4 per cent. on all fish landed direct from the fishing boats ; 5 per cent. on fish arriving from without by rail ; 3 per cent. as auction dues on fish sold by auction to the merchants of Geestmünde. The Prussian Government pockets 1·75 per cent. of these taxes. The dividend distributed is about 5 per cent. Cuxhaven, like IJmuiden, is directly administered by the State, which collects a due of 2 per cent. of the gross sales by auction ; 3 per cent. if the boats do not bring the fish themselves ; and 1 per cent. of the gross sales for the use of the warehouses.

Thus in Germany there is an actual co-operation between the State and the fishermen. The action of this beneficent partnership surpasses the limits of a single city, thanks to the powerful national federation, "The German Society of National Fisheries," which, grouping all the local associations as so many chambers of commerce of the fishing ports, multiplies and co-ordinates their efforts. It is a kind

of Hanseatic League revived and adapted to present needs.

V

We have now all the elements necessary to a general judgment. First of all, we know what characteristics a fishing port should unite. As I have stated, there are a large number of small ports in France, and abroad, particularly in England and Germany, a small number of large ports. Which is the best? Observation shows that the French method is not. To be worthy of the name, a fishing port must correspond to a section of coast-line large enough to ensure it a heavy tonnage. In Great Britain and Germany such sections exist, and are from 95 to 120 miles in length. (If there are very abundant fishing-grounds at no great distance they may be less distant from one another.) On these conditions only can the port increase in importance. Moreover, it will not prosper unless it is connected to all parts of the Continent by means of a first-class railway service. It must be equipped with machinery that will permit of rapid operations; the trawlers must not be kept lingering at the quays. The fishing-harbour, moreover, must be a homogeneous whole, including everything essential within a narrow radius: quays, markets, packing sheds, railway sidings, coal stores, smoke-houses, warehouses, guano, glue, oil and farina factories, &c. This means that a fishing port must be administered upon different principles to those which form the basis of exploitation of the ordinary commercial port. There should be nothing in common between the administrations of the two, even though they lie in juxtaposition. I have given historical reasons for this distinction.¹ The

¹ See Part II., Chapter I.

budgetary autonomy of the British and German ports affords an experimental proof of this principle.

It is to the interest of France to follow these foreign examples ; but she must select with prudence and discernment. Of the two, the German method is closer to the French. The French should adopt it, adapting it to their national temperament.

The essential thing to remember is that there should be fewer small and more large harbours.

CHAPTER III

BOATS AND GEAR

I. The three-masted Newfoundlanders; the Iceland schooners; herring and tunny boats—Small sailing vessels: *étadiers*, feluccas, Biscayans, tartanes—Foreign sailing vessels—Various rigs. II. Steam trawlers—Line-fishing vessels—Drifters—Motor-boats; pinnaces; Scotch herring boats, &c. III. Classification of fishing tackle—The otter-trawl—The beam-trawl, the ox-net, bag-trawl, or *gangui*; the seine or sean; the herring fishery in Norway. IV. Drift-nets; herring-nets—Fixed tackle: traps, eel-pots; tunny-nets (*madragues*)—Baited devices; the sardine-net of the Atlantic coast—Lines; cod fishing. V. Conclusion.

IN France the dispersion of harbours inevitably means the dispersion of boats. The 25,000 sailing vessels of the French coast belong to many widely differing types, which correspond with local traditions and requirements. I will pass in review the principal types of sailing vessels, steamboats, and motor-boats.

I

The largest sailing vessels employed in the French fishing industry are the three-masted vessels of Fécamp. One of the finest of these, the *Masséna*, is of 459 gross tonnage, and is 140 feet in length, the beam being 30 feet; the sail-area is 1,490 square yards. The majority of these vessels carry yards only on the foremast; they are therefore of the three-masted schooner type. Those

of Granville are smaller, varying from 80 to 250 tons. The three-masted Newfoundlanders are constructed on the same lines as ordinary three-masted vessels; there are, however, certain modifications of detail; on that portion of the deck between the forecastle and the foremast are blocks for the reception of the "dories"¹; the deck amidships is unencumbered, to give room for the movable "parks" or wooden frames into which the cod are thrown pell-mell as they are taken out of the water; finally, the hold is divided with compartments for the reception of the salted fish.

The Iceland fishermen employ schooners, luggers, or ketches. The first, recognisable by their two tall masts, do not exceed 124 feet in length nor 23 feet in beam. They are topsail or square-rigged schooners; that is, the foremast has yards, while the mainmast has only a mainsail and topsail. The luggers have a foremast set nearly at the stem, a mainmast and a jigger; the largest are 75 feet in length and 21 feet in beam. The "Dundee" or ketch has a mainmast, with mainsail and topsail, and a mizzen just forward of the rudder. Its length and beam are respectively 50 feet and 16 feet. These boats are usually divided by bulkheads into three compartments; forward is the forecastle, with bunks for the crew; in the centre the holds for the cod and for salt; and the cabin or cabins of the captain and his mate or mates are aft. On the deck, aft of each mast, is a "park" or frame (like the sides of a shallow box), into which the newly caught fish are thrown.

Among the larger sailing vessels engaged in the French coast fisheries are the herring boats, the tunny boats, and the lobster boats.

¹ Light boats, without a keel, of American origin, costing about £4 10s. each. They fit into one another, the thwarts being movable.

The herring boats (*harenguiers*) of Boulogne are of two types. I give their description after M. Soé, the well-known naval architect. The smallest of these types is of English origin ; it is denoted by the two letters P.L. The larger originated in Boulogne. One of the last to be built, the *Aimée*, has a total length of 111 feet, a width on the beam of 25 feet 9 inches, and a gross tonnage of 172. The rest are from 50 feet to 95 feet in length. They are all two-masted vessels. What strikes one at first sight is the heavy forward rake of the mizzen. This arrangement is due to the fact that the sail is extremely heavy, and might carry away the mast were not the centre of the sail hung well forward. Another peculiarity of these boats is the arched form of the bar on which the block of the main-sheet runs, which is just forward of the mizzen-mast. The deck between the masts is covered with numerous hatches, which cover the holds for the fish. Finally, on each vessel is a donkey-engine, which works a winch or capstan set to the port side of the mizzen-mast. The herring boats of Fécamp are built on very similar lines. The vessels are used for the herring fishery and for the Irish mackerel fishery. The tunny boats (*thoniers*) are large *dundeels* (ketches) of 40 to 60 tons, with foremast, mainmast, and jigger. They hail mostly from Groix, Lorient, Sables-d'Olonne, La Rochelle, and Royan. The lobster boats are notable for their pierced holds for keeping the catch alive. At Paimpol they are cutters about 50 feet in length ; at Roscoff they are brigantines.

The lesser fisheries are carried on by means of small boats, usually of the cutter or sloop type, but bearing local names. From Dunkirk to Calais sloops and *dundeels* are in common use. The *étadiers* commence at Crotoy and are found as far as Saint-Valery-sur-

Somme. Boulogne and Dieppe send out luggers and yawls, some decked, some open. The cliffs of the Pays de Caux, between Fécamp and Havre, shelter *caïques*, *picoteux*, and sloops. The shrimp and flounder boats and the "Norwegians" of the Basse-Seine go up as far as Berville. Trouville and Villerville send out large open boats and *plates*. Between Port-en-Bessin and Barfleur the cutter rig is common ; at Isigny they are accompanied by *goguets*. The fishers of the Hougue favour the *flambart*, and those of Cherbourg the cutter and the *vaguelotte*. The Biscayans drag their trawls off Granville, Cancale, and Saint-Malo, and are found as far as Treguier, together with the cutters of Saint-Servan and the luggers of Dinan. After a reappearance of the *flambarts* at Lannion, the rest of the small boats used on the coast are chiefly open boats and cutters.

The fishing fleets of the sardine ports of Camaret, Douarnenez, Concarneau, and Port-Louis consist of large open boats with two masts. At Camaret there are also lobster boats ; at Concarneau, Audierne, Auray, and Belle-Isle, *dundees*. Cutters are seen once more at Noirmoutiers, and from Isle d'Oléron to Royan there is a regular medley of rigs : ketches, cutters, luggers, yawls—all decked—and open boats known as *lasses*, which hail particularly from Royan. Pauillac sends out small *filardières*, small yawls and *calups*. In Arcachon we find for the first time the *tilloles* or *pinasses*, which ply along the coast of the Landes as far as Bayonne, where they are seen in company with *trainières*. The Mediterranean boats all belong to the Latin type ; they are *tartanes*, *mouré de pouar*, *bettes*, *gourses*, and *barquettes* ; that is, they are mostly of the felucca rig, with short masts raking heavily forward. Some are large, heavily ballasted boats with one huge lateen sail ; some have

two lateens; sometimes the coasting traders even combine a square-rigged foremast with a lateen mainsail or mizzen. The *tartanes*, which are long and narrow, have often a raised stem and stern, curving upwards out of the water. They are 36 to 50 feet long and their tonnage is from 25 to 30. They carry a short upright mast and a bowsprit. On the mast is hung a long curved gaff or *antenne* (so called because its form reminds one of the antennæ of the locust or *cicada*), on which is set a large triangular sail—the lateen of the English sailmaker. The fore end of the *antenne* is always fixed to the stem of the boat by means of a link. Tartanes are seen in plenty at Martigues and at Cette. The *mouré de pouar*, with or without a cutwater, and the *bettes* are light vessels which can hoist a lateen. The *gourses*, of Catalan origin, have their only mast raking strongly forward.¹

This rapid glance at the types of French sailing boats is enough to show the multiplicity of types and rigs. Each type is in some degree the result of the needs and traditions of a district; it is an effect of the oecumene. Although less numerous in England and Germany, they are mostly of the same type as the French boats of the Channel and the Atlantic coast. The Lowestoft

¹ The values of the different types of fishing boats are much as follows: Three-masted schooners or barquentines ("Newfoundlanders"), £3,600 to £6,800; Iceland schooners, £2,000; *dundeeds* (ketches) and luggers, Granville, £1,200 to £1,600; herring boats, £1,600 to £1,800; tunny boats, £600 to £800; cutters and ketches, Dunkirk and Calais, £16 to £32; *étadiers*, £80; Boulogne and Dieppe sailing boats, £104, £48, £24; *caïques*, £64, £32; *picoteux*, £10; Norwegians, or prams, £6; sailing boats, Trouville and Villeville, £720; cutters, Cherbourg, £160; *bisquines*, £52; large cutters, Camaret to Port-Louis, £48; ketches, Concarneau, Audierne, Auray, Belle-Isle; and ketches, Ile-d'Oléron to Royan, £200 to £520; *filardières*, £60; yawls, £28 to £40; *lasses*, £8; *filardières*, Pauillac, £26; small yawls, £14; *calups*, £6; *tilloles* or *pinasses*, £6 to £12.

trawlers, which work in the North Sea, on the Sole Pit, and the Dowsing and Leman Banks, are neat ketches of 30 to 50 tons. The Gloucester (U.S.A.) trawlers are schooners. The herring boats of the east coast of Scotland have two masts; the mainmast is fixed and rakes forward but the foremast can be lowered into a crutch, in order to minimise rolling and to keep the boat's head to the sea when "drifting." The herring boats of the west coast, or "skiffs" of Loch Fyne, are ketches, the mast raking aft. The German and Scandinavian cutter, as well as the *Swerkutter* of the lower Elbe, is properly speaking a Dundee ketch. We must not forget the Swedish boats, the Danish *bouticlars*, *beiboots*, and cutters, the light rowing-boats, &c.

Before this medley of forms we cannot but feel a little giddy. We ask ourselves whether, in addition to the local factors which have evoked them, there are none which have a more general bearing. My worthy friend M. Jean Reusser, deep-sea captain of the first-class and ensign in the Naval Reserve, has offered me the following explanation: We must start from this principle: that a sailing boat has to seek the wind at a certain height above the water. Now two cases present themselves: the sailing vessel must either brave the strong winds of the Atlantic, the Channel, or the North Sea, or it has to navigate in a region of light winds: for example, in the Mediterranean. Its general form will depend upon these two factors. Strong winds demand a stable hull—what we call a "stiff" boat. The hull will thus be wide, and will permit the use of tall masts; consequently there is no need for a high gaff or sharply pointed topsail. The vessel will be a cutter, yawl, ketch, or schooner. The result of light winds is entirely different. They permit the use of long, narrow vessels which make for speed. A

small beam means that the shrouds have little purchase ; hence tall masts are impossible. To make up for the shortness of the mast the fisherman is forced to hoist a long pointed gaff, in order to catch the wind. The boat then becomes a *tartane*. It is true that the Portuguese have retained the *antenne*, or lateen gaff, although they face the Atlantic; but this is probably a survival of Mediterranean methods ; for navigation was first organised in the Mediterranean, so that it is natural to find its methods transported.

II

The consideration of steamboats will not delay us long, as those used in fishing are of three types only : trawlers, drifters, and line-fishers.

Trawlers are strongly built iron vessels of 200 to 400 tons gross : they are propelled by engines of 400 to 600 h.p. The largest are 130 to 160 feet in length ; their value varies from £5,600 to £10,000. The crew is 20 to 30 strong. The chief characteristics of the trawler are : a low freeboard, to facilitate the boarding of the trawl ; a flush deck, to allow for handling the trawl and discharging the fish wholesale into the "parks" from the pocket of the trawl (these "parks" are aft of the foremast) ; a powerful winch forward of the pilot-house, and sheaves for the trawl-rope on the deck ; a well-protected screw propeller ; a spacious hold for the fish, fitted with shelves ; and a hold for ice, or a refrigerating apparatus. The *Nordcaper* of Arcachon, of 400 tons, and the *Marie-Marcelle* of La Rochelle, launched at Chantenay from the shipbuilding yard of A. Blasse, are 131 feet in length and 24 feet in beam. The *Jupiter*, of Havre, of 270 tons, was built by Scott, at Bowling, near Glasgow. Boulogne has acquired four splendid specimens of trawlers during

the last two or three years : the *Occident* and *Orient*, each of 300 tons and developing 500 h.p., and the *Europe* and *Amérique*. The *Rorqual*, of Arcachon, launched from the Altringham yard at South Shields, is the largest trawler afloat. Her length is 167 feet ; beam, 27 feet ; depth, 15 feet 6 inches. The hold for the fish has a capacity of 244 cubic yards. It is furnished with cork-lined partitions and cooled by a powerful refrigerating plant. There is no lack of ventilation. All the shelves and partitions in the hold are movable and of galvanised iron ; they can easily be removed if the hold is to be filled pell-mell with salted cod. The engine is a compound triple-expansion model of 750 h.p.

Trawlers are employed in the Newfoundland and Iceland fisheries. They work across the continental Atlantic plateau, from the south of Ireland to Cape Vincent ; along the coasts of Morocco (a few in the Baie du Lévrier), all over the Channel, and in the North Sea. English and German trawlers until recently frequented the White Sea.

Line boats, or line trawlers, fish only with the line. They are small steamers of 20 to 25 tons, 40 to 60 feet in length, propelled by engines of 40 to 115 h.p. They cost from £1,400 to £1,600, and their crews do not exceed twelve. Many are built of timber. "Since the adoption of metallic construction," says M. Soé, "the desire for speed (often more than 9 knots at trials) has resulted in the loading of vessels with machinery, so that the amidship sections necessarily become almost strictly circular in their lower portions, in order to make room for the huge boiler, which greatly adds to the tonnage of the vessel. From the very first a curious fact was to be observed, which has, for that matter, been noticeable more or less everywhere since the advent of iron ships.

I am referring to the relinquishment of lines like those of sailing vessels, although these have given excellent results both in point of speed and steadiness, and the adoption, hardly justified for such small vessels, of forms analogous to those of large steamers. . . . Owing to the importance of the machinery, most line-fishing vessels have only a very small hold. . . . According to the season and the locality, they capture conger, rays, haddock, dabs, plaice, &c. Their voyages are usually only of some 18 or 20 hours' duration ; the moment the fish is landed, the lines prepared, and stores of provisions, coal, water, ice, &c., are renewed, the boat departs again with all speed for the fishing-grounds." These boats are nearly all owned in Boulogne. Those of Aberdeen are generally larger than those described above.

The steam *drifters* are steam herring boats. They have the chief characteristics of the sailing vessels—a hold with many hatches and a capstan on one side. The Scotch ports own more than 500 of these boats. The Boulogne drifters have two rudders—one at the stern and one at the bows. The foremast is always made to lower. The motor-boats¹ remain to be considered. There are a dozen at Boulogne, a score along the Norman and Breton coasts, a dozen on the coast of Vendée and Charente, and four in the Basque country. Arcachon holds the record with 279 motor-launches ! A few herring boats have been fitted with two petrol motors, one of 150 to 200 h.p. to drive the propeller, and one of 25 or

¹ In the smaller English ports it is not uncommon to see smacks, drifters, or small trawlers fitted (sometimes by the fishermen themselves) with small motors and three- or four-inch propellers, giving a speed of 4 or 5 knots. The propeller is only for use in calms, or against the tide, or navigating an estuary at low tide in a narrow channel, or in taking up moorings.—[TRANS.]

30 h.p. to work the capstan. Trouville possesses one or two large petrol vessels. The *Libellule*, an Arcachon launch, is 38 feet long, 5 feet in beam, and 6 feet 6 inches in depth. Its motor (by Conach, of Arcachon) is a four-cylinder model of 15 h.p., which gives a speed of slightly more than 9 knots. These motor-launches fish for sardines nearly all the year, going as far as 30 to 35 miles from Arcachon. But motors are not found only on small boats; the largest live-cage schooner flying the French flag, the *Langousti*, of Paimpol, is furnished with a Dau four-cylinder motor of 50 h.p., which drives a screw nearly 6 inches in diameter. At Dunkirk, motors have been fitted to the herring boats (cutters). Many Scotch herring boats have motors, as well as the majority of German fishing boats, and nearly all the Danish *bouticlars*. The numerous Sicilian fishermen settled at Boston, U.S.A., employ motor-dories. In 1909 a few motor-boats were seen on the Newfoundland banks fishing for cod.

III

The sundry species of fishing gear are as varied and as numerous as the types of boats.

The principle of capture depends upon four biological facts: (1) the number of edible fish is immense; (2) fish are voracious; (3) they are shortsighted; (4) they are subject to almost unchangeable hereditary instincts; and upon this fact of the oceanographical category: that fish keep to depths and localities easily accessible and recognisable. These premises granted, three methods are available to the fisherman: he may capture the fish by force, or he may leave it to get caught by its own action, or he may attract it and take it. From these three methods the three classes of device are derived. In the

first case the effort is great, but the result rewards the fisherman for his effort—for muscular fatigue, dangers endured, and capital invested. In the second the effort is reduced to the minimum possible; what is of more importance is the judicious organisation of the work of capture. In the third case the effort is increased and expenses are higher. These three categories are known as the categories of drag-nets (trawl, seine, *gangui*); drift-nets or fixed nets (herring-nets, Norwegian herring-nets, trap-nets, stake-nets, basket-traps, &c.); and fishing lines (cod lines, haddock lines, conger lines, &c.). The drift-nets take the most fish; the lines the fewest. But we must remember that drift-nets catch such fish as unite in enormous shoals, such as herring and sardines.

The specialisation of fishing gear is not extreme. One species of fish may be caught in many ways. The mackerel is sometimes taken with a drift-net, sometimes with lines, sometimes with the otter-trawl. The drift-net, the beam-trawl (from the end of December to February) and the seine are all used with success in taking the herring. The sardine becomes "meshed" in drift-nets and surrounded by seines. The plaice and the flounder are taken by line as well as by the trawl. The cod is taken with the trawl, the line, and by traps. In short, the gear is apparently less adapted to the fish than to the habits of the fisherman. The same remark is true of the small fishing boats, which are adapted primarily to local nautical necessities; they are, in a sense, shaped thereby, and depend very little upon the kind of gear employed. Trawlers, on the other hand, drifters, line trawlers, and even herring boats—but more particularly trawlers—are differentiated by and adapted to a particular function; their tonnage, their lines, and their motive power give them a relative independence of movement,

but assign them a particular part. The trawler is adapted only to trawling ; but it can trawl in the Atlantic as in the North Sea, on the Newfoundland banks as in the White Sea. The most powerful engine of capture, which is more or less universal, is the otter-trawl, still known in France as the *chalut à panneaux* (trap- or snare-trawl), *chalut à planches* (plank-trawl), *chalut à plateaux* (panel-trawl). All steam trawlers are provided with this net ; hence their name. The trawl consists of a conical bag about 130 feet long and 90 to 100 feet wide. On either side of the opening there are two stout boards, edged with iron, to which the drag-ropes are attached, and attachment is so contrived that the pull upon these ropes, combined with the resistance of the water, separates the boards and holds the net wide open. The width of the boards is usually about 4 feet, but some are as much as 6 feet in width. The otter-trawl costs from £100 to £120. What renders the otter-trawl so deadly is the fact that the upper edge of the mouth of the net is often as much as 25 feet or more above the bottom. Moreover, the otter-trawl can be towed between two superimposed currents of water. To manipulate the trawl the vessel gets the wind on the beam, so as to keep the side on which the trawl was heaved over to windward. The pocket and the net are first thrown into the water ; then the forward board is lowered, followed by the rear board. The vessel then forges slowly ahead, steering so as to work towards the side on which the trawl was dropped. The two ropes are paid out from the capstan, and are three or four times as long as the water to be fished is deep. While trawling, the speed of the vessel is from $2\frac{1}{2}$ to 5 knots.

Next to the otter-trawl comes the *beam-trawl*. This is the older form of trawl, in which the bag of the net is

held open by a beam. It is less adaptable and less handy than the otter-trawl, is not so large, and is consequently less productive. In France it is employed only by the small sailing trawlers or smacks. This trawl presents local modifications, such as the *chalut à patin* (skate trawl, in which the iron stirrups which hold the beam—to which the *upper* edge of the net is attached—off the bottom are replaced by irons shaped like an old-fashioned skate-iron), the *chalut à pierre*, &c. The beam-trawl as used in France is a conical bag 65 feet long by 16 feet wide; but the English beam-trawl, still in general use, has a beam of 40, 70, and even 90 feet. The pocket is of finer mesh, and the upper and lower surfaces of the net are laced together, except for a passage in the centre, which has a valve or flap of netting, which prevents the escape of the fish netted. The pocket being of much finer mesh, even the side “traps” are kept inflated by the pressure of the water. The lower surface of the net, edged with an old rope bound round with smaller cord (old so that it will snap sooner than the warp if caught upon rocks) is cut back in a V, so that the bottom fish are already entrapped on both sides when disturbed. The pocket is laced by a removable cord at the extremity; when hanging over the deck from the hoisting tackle this cord is removed and the contents of the pocket fall on the deck.

The net known in France as the *filet-bœuf* (ox-net or ox-trawl), or the *grand-gangui*, consists of a conical pocket preceded by two lateral wings. The pocket is about 90 feet long. From the front it presents four convex edges—upper, lower, and lateral—and this portion is made of cords, which determine the curves of these faces, and of meshes of hemp fastened to these cords. The upper face is fitted with a string-buoy of

cork, which prevents the net from collapsing ; the lower edge is loaded with a string or selvedge of leaden weights. The net grows narrower towards the end, but finally grows wider once more, so as to form an after-pocket. From either side, both top and bottom of the net, run four cords. The wings are 4 feet long, and the warps are fastened to them. The ox-trawl is drawn by *two* vessels—*tartanes*. It costs £16 to £24. The varieties of the ox-trawl are numerous. In the *gangui à la voile* the wings are very wide apart and the pocket very narrow ; this net is used especially on bottoms covered with mud or growths of *zostera*. In the *issaugue* the wings are out of all proportion long and the pocket small and almost spherical.

The shrimp-trawl, the seine, the ground-seine, the ordinary drag-net, &c., are other forms in common use. The Basques and Spaniards use the long seine to enclose the shoals of sardine. Although modified under the name of Belot seines or Guezennec seines, they have not been permanently adopted by the French fishermen. The *smurpenot* is a "turning" seine used for catching herring ; the Germans, Danes, Norwegians, and some of the Fécamp fishermen use it in Icelandic waters.

Along the Norwegian coasts the fishermen take the herring in a very picturesque manner, similar in some of its methods to the pilchard fishery of St. Ives. Directly a shoal of herring is espied those interested are warned by semaphore. Motor-boats and sailing boats make a rush for the fjord denoted, and the situation of the shoal is ascertained by the water-telescope and by soundings. Then the fjord is barred or the shoal encircled by means of a *lanndvade*—that is, an impassable circle of nets of a very small mesh—three-fifths of an inch on the side. Next comes the business of landing the fish. To that

end a seine is run round the shoal inside the enclosure, and amidst a storm of shouting and yelling, a truly infernal uproar, the fishermen plunge into the water wooden silhouettes of porpoises and voracious fish, so that what with the action of the seine and the terror with which the fish are inspired they are concentrated in a compact mass. The seine is then drawn into shallow water and the fish are taken out at leisure.

IV

We will now proceed to examine the second class of devices, by means of which the fish is allowed to capture itself, namely, the class of which the drift-net is the best-known example.

The herring-net as used in France is of cotton, water-proofed with rubber or coal-tar. The meshes measure 9 to 1 inch on the side. The length of each net is about 80 feet and its depth 36 feet. By joining a number of nets end to end the drift-net is obtained as used. The length of a complete net thus made up varies from $3\frac{3}{4}$ to nearly 5 miles and costs a sum of £800. When the net is to be used it is suspended from a warp, which carries numbers of small kegs or kerosene tins or tin pocket-flasks as floats; corks are less frequently used, being heavy and not so buoyant. The lower edge of the length is hung sometimes with small leads, but usually with old nets, their weight being sufficient to stretch the net without detracting from its suppleness. The herring boat pays out the net over the stern, the drifter over the bows (whence the rudder at the bows and the lowered mast) while going astern at a rate of two or three knots. The net is shot in the evening, as the fish are taken at night. The net is shot across the tide and the vessel rides at the end of the warp with sails set aft, so that her

head is to the wind, and the fish become caught by the gills in the meshes.

The mackerel-net is almost identical with the herring-net, only the meshes are half as large again.

The Mediterranean sardine-net is boat-shaped as seen from above and pointed at either end. It is about 160 feet long and 40 feet wide. The lower edge is loaded with lead ; the upper edge is buoyed by means of corks. The meshes are of linen thread and very fine. The *battude* and *veiradière* are of a similar type. The principle of action is the same in all : the fish rushes into the meshes and is caught by the gills.

The *casier* and the *diable*—both on the principle of the eel-pot or crab-pot—are very easy to handle ; they are simply sunk and left to themselves for a time. The *diable* is used in the estuary of the Seine for catching sprats, herrings, and shrimps. It consists of a pyramidal bag of netting some 20 feet long, mounted on a frame of wood measuring 16 feet by 6 feet 6 inches. To this frame is attached a weight and an anchor, which hold the net lying on the bottom, while a couple of floats betray its location.

With trap-nets and dredge-nets (which are *not* drag-nets) we come to the series of fixed gear. These are also known in France as fish-parks or fisheries and include mullet-nets, crawls, tunny-nets, stake-nets, &c.

Trap-nets and dredge-nets (*filet-dragues*, which we owe to M. Ruret) are enclosures of network moored by means of anchors not far from the shore. They are used in Newfoundland for cod and in Norway for salmon. The mullet-nets of the Gulf of Marseilles are shaped like enormous spouts, the sides being more or less vertical and the lower portion inclined obliquely. They catch

many kinds of fish—mullet, sardines, mackerel, eels, “surmullet,” bream, sand-eels, &c.

The *bordigues* (crawls) are “parks” or labyrinths made of wickerwork or wattled reeds. They are placed in the channels connecting the fishponds of the coast with the sea; at Les Martigues, Port-de-Bouc, Aigues-Mortes, &c. The largest in use is nearly 1,000 feet long and 330 feet wide. *Madragues* are widely used in the Mediterranean, along the coasts of Provence, Algeria, and Tunis, in 10 to 16 fathoms of water. A *madrague*, or tunny-net, is theoretically a series of chambers of network attached to stakes. One of these chambers is open to the sea at the end of a long barrier of nets known as the tail (*coda* or *queue*). The tail stops the fish and shepherds them to the opening. Once they have entered the first chamber they find their way into the others and crowd together in the last—the “chamber of death,” or *corpo*. There they are killed with clubs and harpoons and the bodies removed by means of the latter. The series of chambers measures about 1,000 feet long and 230 feet wide. The tail is nearly a mile in length. The most important *madragues*, or tunny fisheries, of this description are those of Sidi-Daoud at Cap Bon, of Monastir and Kuriat to the south of Susa, and of Bordj-Khadidja to the south of Madhia. These take tunny almost exclusively. Around Marseilles there are numbers of *madragues*—the *madrague* of Vilon, of Gignac, and of Niolon—which catch tunny, bonito, mackerel, bream, and sardines.

The third and last class of devices includes the sardine-nets of the Atlantic coast and all arrangements of hand-lines and fixed or buoyed lines which before capturing the fish attract them by some kind of bait.

The sardine-nets which are used from Camaret to Biarritz are drift-nets, similar to the herring-nets. They

are 33 to 44 yards long and 19 to 22 feet deep ; the upper warp is provided with corks and the lower with leads. They are made of very fine linen or cotton thread and are usually dyed blue. The net is shot over the stern of the boat, while a loose bait of *rogue* (salted cod's roe, crumbled, often mixed with sand) is thrown into the water right and left, its object being to attract the sardine to the surface. Directly the fish are seen to be "working" on one side of the net the men continue to throw the *rogue* on the other side, and the sardine, rushing after the bait, is caught by its gills in a mesh of the net.

The Atlantic tunny, or *germon*, is taken by a line dragged through the water by a moving vessel. These lines are suspended from two "perches"—rods or poles 50 to 60 feet or more in length—of which one is fixed on either side of the mainmast of the vessel. The lines are of hemp and about 360 feet in length, and each is furnished with a double-barbed hook. Six of these lines are attached to each perch. The hooks are baited with a tuft of bleached horsehair and a piece of maize-straw. The tunny rushes violently at the hook, which hops along the surface of the water ; it is drawn on board and killed by the stab of a kind of awl in the brain.

The sailing vessels of the Newfoundland and Iceland banks fish for cod with the line. In the Newfoundland fishery the *harouelles* or bottom lines are set at a depth of over 50 fathoms. The fishermen, when their vessel is perhaps 250 miles from the nearest land, put out in their dories. Each dory sets 24 lines in the course of a day, and as the vessel is equipped with a dozen dories, the daily total is usually more than 250 lines, or nearly 2,000 hooks. The lines are left for twelve hours, from four in the afternoon until four the next morning. The bait consists of scraps of fish or

salted herring, caplin, or molluscs. In 1906 and 1907 certain skippers set their lines between two currents ; a method which yielded excellent results. The Portuguese "Newfoundlanders" fish the Grand Banks near Virgin's Rocks with hand-lines in a depth of about 10 fathoms.

On the Iceland banks hand-lines are used from the schooners' decks. These lines, which are from 40 to 110 yards in length, are fitted each with a lead of 6 lbs. or 7 lbs. weight and a hook baited with lard or scraps of fish. The fishermen give the line an up-and-down vertical movement to attract the fish. It may be imagined that fishing on the banks is a hard and miserable trade. Exposed to storms, icebergs, fogs, and collisions, the fisherman is crushed by efforts which reach the limits of human endurance. When by chance he has time to rest he has only a filthy hole to retire to—a miserable fo'c'sle smelling of sea-water and stale fish.

Lastly, we must consider the long line. This consists of lengths of 100 to 160 yards, furnished with as many hooks. On board, each length is placed in a wicker basket. A *cordier*, or "line-trawler," carries from 100 to 200 baskets, giving 9 to 18 miles of line. The hooks are baited with slips of herring or squid, and the lines are drawn over the slopes of the banks at a speed of five or six knots, trailing from the stern of the boat, which may keep a straight or a zigzag course. Scotland, England, Fécamp, and most of the northern ports fit out line-fishing smacks. In this way cod, haddock, ling, rays, plaice, bream, flounders, and mackerel are caught.

V

With the exception of the otter-trawl, the types of fishing-gear in use are very ancient, and have come

down the ages with little modification. For some years now experiments have been made ; some have been crowned with success ; others have not as yet reached a practical stage. For example, a number of owners have fitted the lower warp of the otter-trawl with rollers, to facilitate the passage of the net over the bottom. The use of floating anchors has also become more general in drift-net fishing, to prevent the boat from making too much leeway. In October–November, 1907, a new trawl was tried at Boulogne. This was intended for use between two layers of different temperature or direction ; it was furnished with two electric lamps fitted with lenses, which were designed to attract the fish before the opening of the net. The lamps (of the Audran-Manière type) could be lit and extinguished at regular intervals. The fishermen of Helmsdale in Scotland have experimented in the substitution of ramie thread for cotton thread in the making of nets. Ramie thread is more flexible and more durable ; but its diameter is rather too great. Inventors should consider the production of a device capable of capturing herring and mackerel at the moment when, after migration, they disappear into deep water.¹

To sum up : the most important device, the universal weapon, which may be adapted to the most various ends, is the otter-trawl. Perhaps the secret of its efficiency lies in the fact that of all fishing-gear its form and mechanism are most like the form and physiology of the great fish-eating fish and mammals. Is it not like an enormous fish with a gaping gullet ? The last step of progress is often a return to nature.

¹ See pp. 167, 169.

CHAPTER IV

THE FISHERMEN

- I. The share system—Its mechanism—Boulogne, and its local complications : Fécamp. II. Fitting-out for the ocean fisheries—Modes of payment : by the fifth ; by the task ; by the quintal ; by shares ; by weekly or monthly wage. III. Summary—Wages at Boulogne and abroad. IV. Various forms of organisation among ocean-going fishermen ; insurance societies ; *Crédit Maritime*. V. Arbitration—The maritime inscripts and the State ; the Naval Pensioners' Fund (*Caisse des invalides de la marine*) ; the Prudential Fund (*Caisse de prévoyance*) ; the law of April 17, 1907.

THE imperfect development of the sea-board œcumene has made of the French fisherman the man we all know ; an essentially local product, very like his brother the farmer ; in short, a creature still somewhat primitive. Now, if we know something of primitive societies, no matter what their period or locality, we know that very diverse and complex forms of organisation are found in their midst. It is quite an arduous task to give an account of the relations between fishermen and shipowners, fishermen and net-owners, &c.

I

The fisherman may own his boat, or own (more probably) a share of it, or he may be a wage-earner.

This aspect of the question is simple enough in appearance ; it is not so in reality, as the possible financial combinations are almost unlimited, and it is not unusual, on board one vessel and on the same voyage, to find the most varied methods of payment. These methods very commonly partake of a system still very general—the system of shares.*

The simplest form of this system is the following : At Douarnenez, for example, every *patron* or master-fisher, owning his cutter, fits it out and equips it with sails, rigging, and nets. The fish being sold, the general expenses are deducted and the net profits halved ; one-half goes to the master, one to the men. At Concarneau eleven shares are divided among six persons thus : five and a half shares to the master, five to the men, and half a share to the boy. When the boat is owned by several fishermen there are one or two shares reserved to the boat as well as the shares which are divided equally among the men. A cutter manned by six men would probably take two shares, and the men a share apiece, making eight equal shares, so that the owner would take three ; or if owned by two men each would take two shares. In the case of the ox-trawl or *gangui* drawn by two *tartanes*, the net

* In English ports, in the old days, not only fishing boats, but also merchant vessels, and even privateers, and (in Cornwall especially) smugglers and pirates, were “farmed” for the voyage or the term : that is, the ship was hired from the owner by a loosely-compacted group of shareholders, who put up the money to fit and provision the vessel, pay the crew, and buy a cargo, afterwards dividing the profits in proportion. About ten years ago, during the decline of the Dundee whaling trade, many whaling vessels were “farmed” for the voyage by groups of friends and relations of both sexes, the captain usually “standing in.” In Cornwall the seines are often owned by a landowner or speculator, but the boats (in shares) by the men.—[TRANS.]

profits are halved before being divided among the men, half going to each *tartane*.[†]

When the boat does not belong to the fishermen the boat's share becomes confounded with the owner's share. Thus at Étél the "master-tunny-fisher" takes a part and a half, each man one part, and the ship-owner and proprietor four parts. At Groix six-tenths of the profits go to the crew and four-tenths to the owner. At Boulogne (I quote a report by M. Ch. Brasseur, secretary of the Boulogne Chamber of Commerce) "the division of the expenses and profits is effected, according to determined rules, between the owner or *écoreur*, the boat, and the crew. From the results of the sale 5 per cent. is deducted for the *écoreur*, then all the working expenses, such as the cost of the ice used, the insurance premiums, the nets and extras lost, broken, or worn out; then the rest is shared. Each man and each lot of nets takes half a share. The master, besides his two half-parts (half for the nets and half for the man), has the half-part which is paid for 'skippering' the boat. This is paid him by the owner. The latter has five parts; three and a half for the cutter and dinghy, and one and a half for the gear. In the case of trawlers, after deduction of the *écorage* and all the common expenses, the result of the sale is divided into two parts, one for the boat and one for the crew. . . . In line fishing, two-fifths of the net profits go to the boat, and the rest is divided between the crew and the gear."

[†] Among our English fishermen I have seen the following arrangement: In a salmon-river, a naval pensioner (as a small capitalist) has leased the fishing-rights for a certain reach, or for one hand-seine. Another provides the nets; another owns a seine-boat. One share will go to the net, one to the boat, and one to the tenant of the rights, so that the three capitalists in money and gear will earn twice as much as the helpers.—[TRANS.]

The system is growing more complex ; but this is nothing as yet. Hitherto the system of shares is unmixed ; now we come to a fresh element : the advance made by the owner to the fisherman, which is called, according to its nature, the "lost advance" ; that is, it has not to be repaid to the owner. Or it may be an "advance to count" (*avance à valoir*), if it is to be repaid ; or it may be a "simple gift," or earnest money, *denier à Dieu*. These advances have a sound justification. When the fishing season takes the man away from his family for weeks or months at a time there must be bread in the house.

Let us take a few details relating to the herring and the mackerel fishing of Fécamp. The nets of cotton are furnished by the boat-owner. The latter, the day he engages his crew, gives each sailor a "pure gift," that is, earnest money, to the amount of £16 for the herring fishery ; for the mackerel fishery, which is nearer home, the sum is £6. The fish being sold, the owner or his representative touches a commission on the gross proceeds of the voyage. Then are deducted the advances of salt, cider, wood, coal, ice ; barrels of fish and groceries ; the harbour and custom dues ; the hire of boilers and gear and upkeep of machinery, and the crew's wine-tankards, which are all considered as common expenses. (These precautions are admirable, and the last is really sublime !)

The net yield of the voyage is then shared out at the *Bureau de la Marine*, as follows : The boat, three and a half parts ; the long-boat or dinghy, half a part ; the gear, two parts ; the master, one part ; each sailor, half a part ; each "novice," three-eighths of a part ; each boy, a quarter of a part . . . And the crew is paid !

II

Now the reader can perhaps bear up against the Chinese puzzle of the engagement of sailors for the long-distance fisheries. I will explain in succession the manner of engagement by shares, engagement by the task, and engagement at fixed wages. In the two first cases you will find we must allow for advances—deducted, you may be sure, from the expected gross profit—which may be “lost advances,” “advances to rank,” which vary as to amount, or “pure gifts” of £2 to £16, or earnest money (God’s pence, *denier à Dieu*), amounting to anything between 8s. and £4. The engagement by shares presents three aspects: there is “the engagement by the fifth,” customary at Fécamp; “the engagement by the mitigated fifth,” practised at Saint-Malo, and the “engagement by the third,” also a Saint-Malo custom, but now dying out.

In the “engagement by the fifth” the general expenses are deducted from the gross profits and the net profit is divided by five. Four-fifths go to the shipowner, one-fifth to the crew. This fifth is divided thus: the captain, two or even three parts; the mate and the curer, one and a half parts; the captain of the dories, or bo’sun, one part and £4; the bow hands of the dories, one part; “novices,” three-quarters of a part; the boy, half a part. Finally, the best fishers obtain premiums taken from the crew’s fifth.

The “mitigated fifth” is a better system for the crew, who obtain certain sums in addition to their shares of their fifth. The captain may draw three parts and 5 per cent. of the gross sales; the mate one and a half parts and 4 fr. 50 (3s. 9½d.) per thousand cod; the curer, one and a half parts and 4 fr. (3s. 2½d.)

per thousand cod, and 10 fr. (8s.) per hogshead of oil.

In the case of "engagement by the third," the net profits are divided by three. One third goes to the crew; but the "gratifications" or additional sums are counted in with the general expenses.

Engagement "by the task" takes three forms: "engagement by the last" (the last being two metric tons of 2,205 lbs. each), practised at Gravelines, Dunkirk, and Paimpol; "engagement by the quintal" (a quintal equals 50 kilogrammes of 2,205 lbs. each, or 110.27 lbs. —practically a hundredweight), which is customary at Saint-Malo; and "engagement by the thousand," a form nearly obsolete. The last has not everywhere the same weight; at Paimpol it is equivalent to 2,200 kilogrammes of cod (4,852 lbs.); at Dunkirk to 1,620 kilogrammes (3,573 lbs.). As a rule 35 fr. or 28s. goes to the captain, 25 fr. or 20s. to the mate, 22 fr. or 17s. 7d. to the "master," and 20 fr. or 16s. to the "curer." The rest of the hands receive 2d. per fish caught. In the case of "engagement by the thousand" the bo'sun or dory-master receives £2 per thousand cod, and the bow-hand 28s. to 32s. Before sailing, the owner will stipulate for a certain weight per thousand. The thousand, for example, will weigh 2,200 kilogrammes, or 4,852 lbs., or about 2 tons $3\frac{1}{2}$ cwt. In the case of "engagement by the quintal" some owners of Saint-Malo give the crew 4 fr. 75 per 55 kilogrammes of fish caught.

The *charter-party* is the contract entered into by ship-owners and maritime inscripts. One must read one of these contracts to gain any idea of their complexity. Here are a few clauses from one of these documents, which had its hour of celebrity. It deals with the arrangement concluded last January, at the end of a

dispute, between the syndicate (union) of the shipowners of Saint-Malo and the syndicate of the Newfoundland inscripts :—

ART. 12. For the determination of all wages the cod, whatever its size, shall be taken as thirty quintals the thousand.

The sale price of roes and oils and all products whatsoever will be added to the total from the sale of the cod, subject to the deduction : (1) in the case of oil, of the allowance of the curer ; (2) in the case of cod, of the discount and commission customary at the port of delivery, according to the invoice ; (3) in the case of bait, of its cost price.

(On the thousand of cod, reckoned at thirty quintals per thousand, will then be paid to the crew of each dory, upon the thousands caught by that dory, seven francs per franc of net sales per quintal).

ART 13. Wages on the basis of 20 fr. per quintal are determined as follows :—

The captain or master-fisherman, 1 fr. 50 per quintal of cod (about 1s. 1d. per cwt.). If the fishery is conducted by the master-fisher, the wages of the captain will be deducted from those of the master.

The second in command (whether on shore or at sea) 130 fr. (£5 4s.) per thousand fish, reckoned on the average of all the dories. The salter is paid 9 fr. (7s. 2½d.) per thousand fish on the total catch, and 6 fr. (4s. 9½d.) per hogshead of oil. Apprentices are paid 3 fr. (2s. 4½d.) and boys 2 fr. 50 (2s.) per thousand fish on the total catch.

The master and the mate, if there is one, will receive complementary payments of 1 fr. and 50 centimes respectively per thousand fish on the total catch.

The dory hands will receive 140 fr. (£5 14s.) per

thousand cod caught by their respective dories; the product will be shared between dory-master and the bow-hand in the proportion of five-ninths to the first and four-ninths to the second.

Shipowners may engage an extra dory-master for vessels carrying ten dories, and two for vessels carrying more than ten.

As will be seen from these examples, the whole document is amazingly complex and antiquated.

Finally, let us consider the engagements at fixed wages. The captain of a sailing-vessel receives £4 16s. per month, and the mate £4 8s.; the crew from £16 16s. to £19 4s. for the season; the boys and apprentices from £5 4s. to £6 12s., and the *graviers* £6. *Graviers* are the children and young people who spread the fish on the beach at St. Pierre and Miquelon. The captain of the trawler is on the share system; the mate receives £4 8s. per month; the chief-engineer £8; the men £3 4s. plus an indemnity of 16 fr. (12s. 9½d.) for food. Besides these sums there are gratifications or extras. I know of one Channel port in which the owner of large steam trawlers pays each of his captains £8 per month, plus 4 per cent. on the gross sales; each chief-engineer receives £8, plus 2 per cent., and each of the crew £5 12s., plus 1 per cent.

III

I must now co-ordinate these scattered data and consider what lesson may be drawn from them.

Let us first of all consider the system of remuneration in vogue in the largest French fishing-port—Boulogne. At the end of the eighteenth century, and during the first half of the nineteenth, the shipowners of Boulogne practised the system known as *écorage*. Under the system of *écorage* the master-fisherman and the crew

borrowed from the *écoreur*, that is, the shipowner, such money as they required for the fitting-out and working of the vessel, and at the end of the season paid him the interest on his money at the rate of 5 per cent. of the gross sales. However, as the number of vessels incessantly increased, *écorage* gradually disappeared and was replaced by the share system which I have already described. In its turn, the system of shares is to-day replaced by the system of fixed wages. The introduction of steam trawlers, or in other words the extension of the *œcumene* and the progressive industrialisation of the trade of fishery, has resulted in the introduction of the system of salaried employment among the fishers of Boulogne, as formerly it was introduced into factories and workshops. By this system the shipowner, the proprietor of boats and gear, pays the men by the month—£4 as a rule—and feeds them. Besides this he gives the *patron* a share, and a bonus to the crew, according to the yield of the boat, so that what with wages and “gratifications” the hands may earn a total of £5 a month.

The wage system is widespread in England, Scotland, and Germany. The result is that on one hand you will find capitalists; on the other, fishermen-labourers, to coin a term. They are often ill partners. During the season of 1900–01 the market prices at Grimsby fell so low that the fleet-owners were forced to reduce wages. The fishermen replied by a strike, which lasted six months. At Geestmünde the staff and crew, excepting the captain, go to sea on fixed wages; but they receive the livers of the fish, for which the fish-oil factories offer them regular prices. The captain receives from 6 to 8 per cent. of the sales; the second in command £10 per month; the master £4 15s.; the men £4 5s.; the chief-engineer from £6 to £9 4s., &c.

The wage system is in general more advantageous to the fisherman. Take the share of a Newfoundlander in the product of a season of seven or eight months : it may amount to £40, or £48 to £50, if the season is good. From this, however, we must deduct the expenses of his kit : boots, flannel waistcoats, oilskins ; so that a sheer gain of only £28 to £36 is left. The system of shares has the aspect of a regular co-operative society ; but the two contracting parties are not on a footing of equality—except in the payment of general expenses. General expenses ! The masters are pleasant and charitable folk, and extremely obliging ; they take endless trouble to equip the vessel worthily ; unfortunately, what they give with one hand they take back with the other !

At Boulogne the fisherman "on shares" does not make a net gain of more than £36 to £48 a year, while the wage-earner makes an average of £72, and obtains his food as well. He is hardly ever idle ; the intervals separating the two different kinds of fishery in different seas are always very brief. The movements of the Boulonnaise fleet, counting entries and departures, are represented by 40,000 to 45,000 vessels, and a tonnage of more than $1\frac{1}{2}$ millions. The large sailing vessels go out for a fortnight ; the small steamers for a day or two ; the trawlers for ten or twelve days ; only the vessels fishing the Iceland banks stay at sea a full month.

It is evident that the wage system will spread in direct proportion to the development of the fishing industry ; but it will always be necessary to pay the crew bonuses in proportion to the catch and to pay the captain a fair percentage. A good skipper means a good boat ; it is cheaper to pay well for ten active men than to obtain twenty dawdlers at a bargain. There must be no waste on board, and the catch must be as large as possible.

IV

The seaboard oecumene explains the extreme smallness and isolation of social groups among the fishermen. I have spoken of the morphology of these groups; I must now deal with their physiology. This reduces itself to a study of corporative groupings. The various forms of organisation to be found among sea-going fishermen are the *syndicat*—the “union”—the mutual invalidity societies (of insurance against sickness), companies for insurance against the loss of gear, co-operative societies for the sale of fish, and the *crédit maritime*, the seamen’s banks.

There is scarcely any fishing-port, however small it may be, without its fishermen’s union. The union is supported by subscriptions, and has no other object—in principle, at all events—than the defence of the professional interests of the fishermen. In France there have for some years past been district federations of unions, for example, the Federation of South Finistère. I believe some of these unions have unemployment funds; in any case, the constitution of such funds would be a useful reform.

Invalidity insurance societies are supported by monthly subscriptions of from 25 to 50 centimes—2½d. to 5d. They defray the cost of medicine and treatment, and sometimes also give a daily dole of 1 fr. to 1 fr. 50 (9½d. to 1s. 2½d.).

The societies which insure against the loss of boats, gear, &c., charge a premium which varies from 1·75 per cent. to 3 per cent. of the value of the boats insured, and from 3 per cent. to 6 per cent. of the value of the gear. It often happens, as at Concarneau, that the indemnity paid upon total loss is practically equal to the value of the

boat, irrespective of age. M. Rivoal rightly denounces this system as "defective and dangerous." "The fundamental principle of correct mutual assurance should be an indemnity always in proportion to the value of the boats, which is constantly decreasing."

Mutual assurance societies flourish more particularly in Latin countries. There are none in England; but a few shipowners effect mutual insurances. There are very few in Holland and in Germany; but in Spain and Italy they are legion.

Mutual maritime credit (*crédit maritime mutuel*) is a recent institution in France. Its beginnings were extremely modest. It first appeared in the shape of a co-operative society, of which the deputy M. Le Bail was the promoter, and which concerned itself merely with the purchase of bait (*farine d'arachide*, or earth-nut meal) for sardines. The co-operative society, dealing directly with the producers, lowered and regulated the prices. This was the first step. The second step was officially ratified. On the initiative of M. Le Bail, the French Parliament voted the organic law of the *crédit maritime*, which was promulgated on April 23, 1906.

A maritime credit society, or seamen's bank, operates as follows: The total capital can only consist of paid-up shares; these shares are not transferable, and yield an annual dividend determined by a general meeting, but which must not exceed 5 per cent. of the paid-up capital. The business of such a company may be classified as follows: the issue of loans upon the security of negotiable paper—bills at sight, agreements, warrants, &c., to its shareholders, who must give proof of the utility and the strictly maritime character of the loan, or must give sufficient security; discounting of bills; rediscounting of these bills through a bank, credit society or loan

society after obtaining their endorsement ; undertaking the recovery of debts or payments due to its shareholders ; receiving deposits on current accounts with or without interest ; the contracting of loans necessary to the establishment or increase of its floating capital ; and investing such funds as may be temporarily idle. As a rule, no loan must be contracted for a period exceeding three months. Interest on the loans is higher than the bank-rates of the Bank of France, and a very small monthly commission is charged, for example $\cdot 1$ per cent. The discounting of bills of exchange is subject to the same rule. At the end of the business year 75 per cent. of the net profits are devoted to the constitution of the reserve fund and the surplus is divided among the shareholders in proportion to the interest charged on their operations.

The law of the 23rd April was scarcely promulgated when local funds^{*} were established in the ports of Finistère. These local funds were, however, very small, and their operation hardly differs from those of the former co-operative societies. In order that they should survive and develop themselves, it was necessary to group them together, to co-ordinate them ; in short, to raise them to the rank of district societies. This centralisation fulfils so pressing a necessity that the "Association of Maritime Loans" was founded at Quimper on August 22, 1906, the State making an advance of £4,000, which was paid out of the State subsidies for the Merchant Marine. Since June 18, 1909, the district societies have had a legal existence. Besides advancing ordinary loans, they may advance the local societies special loans for the benefit of the maritime co-operative

^{*} There are to-day seven local funds, six in Finistère and one at Collioures.

societies, and repayable by means of contributions to the sinking fund within a maximum period of ten years. "Thus," writes M. Rivoal, "not only do our district banks discount bills subscribed by the members of the local societies and endorsed by these societies ; but they may also give their consent to special loans exclusively intended for maritime co-operative transactions. In short, the local *caisse* fulfils a double office : it issues personal loans and collective loans under given conditions, as is the case in Denmark.¹ Now that the commercial education of the Breton fishermen is well begun it is possible to induce them to adopt the system of bills of exchange. For the rest, while demanding negotiable effects, nothing will prevent us, as a measure of prudence, from continuing for some time longer to make our local banks simple intermediaries rather than actual banks. If we are correctly informed, this method is that recommended by the Minister of Agriculture in the operation of the agricultural banks. Be this as it may, we can only put up with this state of things so long as those interested are still without the necessary social education or business experience. As soon as we have brought our various groups of sea-going fishermen to the degree of perfection that we aspire to, we shall proceed to transform the local societies into banks, which will undertake as much business as possible.

To sum up, the French fishermen have at their disposal co-operative societies, local institutions of mutual

¹ The law of March 25, 1910, authorises the district banks to receive advances from the State in addition to the sums available as reserves destined for the use of institutions useful to seamen, and in addition to a subsidy of £72,000, proceeding from the 15 per cent. levied upon the profits of gaming in clubs and casinos.

credit, and district banks of the same nature. In Germany and in Norway "maritime credit" has been in operation for the last twelve years, in the form of mortgages advanced by the State to the fisherman, amounting to half the cost of his boat. These loans are free of interest for a period of five years; repayment by annual sums commences the fifth year. In Denmark there are two central State *caisses*; one for the issue of personal maritime loans, and one for the issue of collective loans. In England the State has nothing to do with this kind of business.

It was high time that France was endowed with this institution, which in other countries has breathed new life into the world of fishermen. The small fisherman of the French coasts will assuredly profit by it; but will he be more prudent? Will the fishermen's bank be the signal of his re-awakening, or will it plunge him into a yet profounder sleep? Will it produce strong men capable of growth and expansion, or petty hucksters with one misery the less?

V

We have now reviewed the relation of the fishermen to the shipowners and the main outlines of their co-operative organisations. But nearly all French fishermen are naval inscripts, and as such the State has placed them under its guardianship and under a special jurisdiction.

To begin with, the naval inscripts are amenable, in professional matters, to the maritime courts. However, there are associations of fishermen which are possessed of certain administrative and judicial powers; such is the case with the *Prud'hommes de la Méditerranée*, or arbitration council, whose origin goes back to the

fifteenth century. The *prud'hommes* (arbitrators) are inscripts elected by their peers. They administer the affairs of the community and regulate the workings of the local fisheries. They judge of disputes between fishermen without revision or appeal, and to enforce their sentences they have the right to seize boats and gear and sell them by auction. They impose upon the fishermen a quarterly contribution of 7 to 10 francs; and they employ their available funds in granting pensions and relief.

These groups, as I have previously observed, are anomalies; the naval inscript by definition is directly subject to the Navy Department (or, to be precise, its French equivalent, the Administration of the Marine, which provides him, in his old age, with a pension, through the agency of the *Caisse des Invalides de la Marine* (Naval Pensioners' Fund).

This pensioners' fund (reformed by the law of July 14, 1908) is fed (1) by dividends produced by its holdings of Consols (*Grande Livre de la Dette publique*); (2) by stoppages of 5 per cent. of the wages of inscripts and non-inscripts (men engaged in the petty fisheries paying monthly sums varying from 5 centimes to 7 francs—5d. to 5s. 7½d.); (3) by the shipowners, who pay a contribution equal to three-fifths of the sums due to the Caisse by the persons in their employ, or 3 per cent. of their wages, if they are paid wages, and annual sums amounting to three-fifths of the sums due from those paid on the share system or out of the profits; (4) by the State, which contributes nearly £560,000 annually. A licensed master-fisherman of the Newfoundland or Iceland fishery can draw a pension of from £33 to £37 5s. after the age of sixty, while his widow can draw from £15 4s. to £17 12s., whereas an ordinary

sailor can draw from £14 8s. to £25, and his widow £11 12s.¹

The French Parliament has not confined its solicitude for the fisherman to the above measures. By the law of April 17, 1907, it endeavoured to regulate the conditions of labour and enforce proper hygienic measures on board of all vessels whose tonnage exceeded 25 tons gross.² Although this law was excellently conceived it has led to serious differences between the shipowners and the men.

I will not enter into the details of this law ; but I will cite the principal objections which have been raised against it. In the first place, it is impossible to furnish the Administration with the plans of the majority of the boats (which are required for approval before a permit of navigation can be issued), because they are nearly all built on moulds, and most of the builders would be puzzled to calculate the cubic contents—and even, says M. Soé, the horizontal area of the quarters allotted to the crew. The cubic content of the space allotted to a bunk, for example, should not be less than 2·15 cubic mètres or 76 cubic feet, and its horizontal area 1·15 square mètres or 12·4 square feet per person. To say nothing of the cubic contents, the rule affecting the area is impracticable, as it would involve the reconstruction of all the fishing boats afloat, a process which the fishermen are not in a condition to afford.

¹ Independently of these institutions there has existed since 1894 an influential society entitled the “*Société des œuvres de mer*,” which cares for the sick seamen in Newfoundland and Iceland and sends them home ; it also undertakes the delivery of letters, &c. It owns a steamer, the *Saint François-d’Assise*.

According to the decree of February 11, 1902, the Government distributed to all masters in the North Sea fishery a simple manual containing medical instructions.

² Order of public administration, September 21, 1907.

The cabin should be at least 6 feet high. To obey this prescription the builder would have to advance it almost amidships. Again, there must in no case be more than two bunks superimposed. Now, "the sailing vessels of Boulogne," says M. Soé, "have at present eighteen bunks in the forecastle, nine being arranged on either side in tiers of three. If they were arranged in two tiers only, the forecastle would have to be lengthened by the length of a bunk, or by at least 6 feet, plus the width of a bunk, which is 2 feet, but even if two of the bunks could be set transversely against the after bulkhead, as is done in steamers, it would be difficult to arrange for a hatch and companion against the bulkhead, to give access to the forecastle. And what would be the result of the suppression of the third tier of bunks? To lengthen the forecastle by the necessary amount would mean taking about 8 feet from the hold. Now, the compartments of the hold are nearly 8 feet long, and such a compartment will contain more than 150 barrels of herrings."

My object has been merely to give some indication of the profound perplexity into which this law of April 17 has plunged the builders and owners; the latter, on account of the enormous and unforeseen expense involved, are ordering no new vessels, and the former see their slipways deserted. In a letter which he wrote to the deputy M. Chaumet, M. Bordes, then President of the Central Committee of the Shipowners of France, estimated the cost which would be entailed by the new law at over £340,000. It is hardly worth while to grant subsidies to the merchant marine if the left hand takes back what the right hand gives.¹

¹ A draft of a law modifying the law of April 17, 1907, has been put before the French Parliament.

CHAPTER V

THE PROFIT

- I. The revenue of drift-nets, trawls, and lines in the North Sea, the Channel, the Atlantic, and the Mediterranean.
- II. The revenue of boats; sailing boats and steamers; average productivity.
- III. The earnings of sailing vessels and steamers; economic sketch of the Boulogne district; the size-limit of steamers.
- IV. The earnings of fishermen in France and Great Britain—The yield per square mile of the principal fishing-grounds.

HARBOURS, boats, gear, and fishermen, these are the four implements of fishery. We have considered the implements, and how they are used. We must now consider the pecuniary value of their work. I shall devote two chapters to this subject, dealing with it from the statistical and the economical point of view.

I

First of all let us take the yield of the various kinds of fishing-gear: drift-nets, trawls, lines, stake-nets, *madragues*, trap-nets, &c.

The North Sea alone produces more fish than all the other fishing-grounds exploited by Europeans put together. It yields every year more than *one million tons* of fish. Drift-nets account for exactly half this quantity; the trawl comes next with 350,000 tons; lines take the third place with 35,000 tons. Fixed nets of all kinds, fish-

ponds, estuary fisheries and hand-seines account for the remaining 115,000 tons.

The four species of which the greatest quantities are taken are as follows :—

Herring (drift-nets), 500,000 tons annually ; or 57 per cent. of the fish caught, representing a value of 38 per cent.

Haddock (trawl), 164,000 tons, or 14 per cent. of the fish caught, representing a value of 18·7 per cent.

Cod, 67,000 tons, or 7·5 per cent. of the fish caught, representing a value of 8·2 per cent.

Plaice, 56,000 tons, or 6·2 per cent. of the fish caught, the value being 10·9 per cent. of the total.

Other species of less importance follow : whiting, ling, turbot, soles, flounders. Great Britain is responsible for catching and carrying home to her ports two-thirds of the herring captured and nearly all the fish caught with the trawl. France brings back from the North Sea only 250 tons of cod and 20,000 tons of herring.

Excluding for the moment the large general fisheries, the French fishermen fish more particularly in the waters of the Channel and the Atlantic continental plateau, and the inshore belt of the Mediterranean. The drift-net and the trawl capture the following quantities of fish :—

				Tons per Annum.		
				Drift-nets.		Trawls.
Channel and Atlantic	...	...	...	89,000	...	43,000
Mediterranean	...	...	...	4,000	...	3,000

Among the fish taken in drift-nets the largest figures relate to the herring (40,000 tons in the Channel) and the sardine (36,000 tons in the Atlantic, 2,000 in the Mediterranean). The ratio of fish caught by the drift-net to those taken in the trawl is still the same—50 per cent. ; except in the Mediterranean, where this proportion no longer holds true. To what must this fact be attributed ?

Doubtless to the fact that the currents of the Mediterranean, being very slight, lend themselves less effectively to drifting : while the fixed fisheries of estuaries and fishponds divert a large number of fishermen from active sea-fishery. The annual yield of the Channel and the Atlantic fishponds and estuaries amounts to 2,000 tons (salmon, sturgeon, bar, grey mullet), while the yield of the same species in the Mediterranean amounts to 1,900 tons.

The absolute limit of absorption of a herring-net or a trawl depends in theory upon the number of meshes or the size of the pocket ; but in practice it is conditioned by the nature of the boat. It is obvious, for example, that a small cutter could not drag an otter-trawl ; that a steam trawler or drifter will reach the fishing-grounds more rapidly. It is also imperative to consider the gear as a function of the boat.¹

II

To one who watches, of a morning, in a large and prosperous port such as Grimsby, Hull, or Aberdeen, the arrival of the steam fishing boats, it seems that these powerful and speedy vessels must be the only efficacious agents of intensive production, as well as the regular purveyors to the market. This impression corresponds faithfully to the reality ; a fact of which the reader may convince himself if he will have the patience to follow my argument.

The sailing boat is as ancient, in its application to fishery, as the sail itself. Steam, on the other hand, has been employed only for some fifteen years ; so that we

¹ The greater portion of the two following paragraphs appeared in a monograph of mine published by the *Ligue maritime française* (March-April, 1909).

must not be surprised even to-day to see numerous sailing boats in our fishing ports. The merchant marine of to-day offers a similar spectacle; in 1907 the gross tonnage of steamers rose to 32,245,000 tons, while that of sailing vessels amounted hardly to 7,000,000 tons. What, one may naturally ask, is the ratio of steam and sails in the case of fishing boats?

A detailed examination of the figures relating to Great Britain and France is extremely suggestive: but in order not to confuse our inquiry we will consider only the year 1905, which is almost perfectly typical. Here is the approximate situation of the French and British fisheries on January 1, 1906:—

	VESSELS.		ANNUAL YIELD IN TONS.		
	Steamers.	Sailing Vessels.	Steamers.	Sailing Vessels.	Total.
France	200	25,000	50,000	141,600	191,600
Great Britain ...	2,000	10,000	480,000	478,000	958,000

We see that France has only one-tenth as many steamers as Great Britain, but 25 times as many sailing vessels engaged in her fisheries. I include sailing vessels of all tonnages—the “Norwegians” of Honfleur, the *picoteux* of Havre, as well as the tunny-fishers of Groix. In other words, France has 1 steamer to 125 sailing vessels; and England 1 steamer to 5 sailing vessels. Finally, for an almost equal number of fishermen and a given number of steamers, France possesses fifteen times more sailing vessels than England. In the result, England produces five times as much as France. We may therefore arrive at the following formula, showing that 200 groups composed each of 1 steamer and 125 sailing vessels of all tonnages catch only one-fifth as many fish as 2,000

groups consisting each of 1 steamer and 5 sailing vessels of any tonnage :—

France : 200 (1 steamer + 125 sailing vessels), or $25,200 = 1$.

Great Britain: 2,000 (1 steamer + 5 sailing vessels), or $12,000 = 5$.

This formula deserves a close consideration.

The French steamers are very like, if not identical with the English steamers. As for the sailing vessels of the two countries, they differ less in their methods of fishery than in their tonnage. Since Great Britain has ten times as many steamers as France and 2·5 times fewer sailing vessels, the productivity of the English steamers *should* be ten times as great, and that of the sailing vessels only two-fifths as great; in short, the productivity of England should be 7·5 times greater than that of France. Actually it is only 5 times as great; or 33 per cent. less than it should be. One of two things is true: either this slight advantage on the side of France is due to the very large number of her sailing vessels or the average catch of the English steamers is slightly inferior to that of the French steamers. The second alternative is the fact, as the following table will clearly show :—

AVERAGE PRODUCTIVITY IN TONS PER ANNUM PER STEAMER.

<i>France.</i>		<i>Great Britain.</i>	
Lorient ... 400	} Average 252	Aberdeen ... 290	} Average 240
La Rochelle 130		Grimsby ... 259	
Arcachon ... 230		Hull ... 180	
Boulogne ... 130 (?)			

There is thus a difference of about 10 tons per annum per steamer in favour of the French; the steamers are the principal instruments of production.

We must remember that "a steamer fitted with an otter-trawl and working 20 hours a day at a speed of $2\frac{1}{2}$ knots,

and trawling 300 days in the year, will exploit the sea-bottom over an area of some 83,000 acres—nearly 130 square miles.”¹ We must also remember that in spite of its efficiency it allows 81 small fish to escape through the meshes of the pocket out of every 100 that enter it, so that its efficiency, taking large and small fish together, is 19 per cent. The United Kingdom, less Ireland, possesses four-fifths of the steam trawlers of the world. The enormous mass of fish caught by British trawlers may be divided thus:—

					Percentage of Total.
White Sea and Norwegian Coast	...	...	...	...	57
Iceland and the Faröes	...	...	...	...	28·06
Channel and Irish Sea...	...	...	...	...	4·75
Atlantic (as far as Morocco) and the Baltic	...	...	...	...	9·74
North Sea	...	...	...	...	54·87

If we consider the herring fisheries, the North Sea represents more than 80 per cent. of the total fisheries of the great European nations. The 150 English steam trawlers which work on the Iceland banks bring back 70 tons *net* of fish apiece after a voyage of twenty days, the voyage to Iceland and back included. Since the introduction of drifters into Icelandic waters the herring harvest, during two and a half months, has increased from 40,000 barrels in 1903 to 120,000 in 1905. The steam fishing boats are the kings of the sea.

III

Let us now consider what I have called the rate of yield in the case of sailing vessels as opposed to steamers.

We know that in France the sailing vessels take about 141,600 tons of fish, and as each steamer takes about 250 tons per annum it is therefore obvious that the same

¹ See p. 108.

quantity of fish would be taken by 566 steamers. In other words, 566 steamers could replace 25,000 sailing vessels of all sizes ; or 1 steamer = 44 sailing vessels. In Great Britain the case is different.

A simple calculation shows us that in England 1,991 steamers could replace 10,000 sailing vessels of all sizes ; in other words, 1 steamer = 5 sailing vessels. In other words, the average efficiency of the sailing vessels is 2.5 per cent. in France, but 20 per cent. in England.

The reason for this disproportion is that nearly all the English sailing vessels are large boats. Yarmouth has more than 90 herring boats under sail : Lowestoft has 220. These vessels are 60 feet in length, 18 feet in beam, and 8 feet in depth. The trawling smacks are 65 feet in length, 18 feet in beam, and 16 feet 9 inches in depth.¹

Thus, the efficient fishing boat must be a vessel of sufficient tonnage, and since with size it must combine speed and the most improved gear, steam becomes essential as the mode of propulsion. Not that the sailing vessels have not their uses ; but they undertake work of a different kind. Sailing vessels are best, or at least efficient, for the capture of the best species—"prime" fish—such as soles and turbot ; steamers are best for the capture of widely-sold species such as haddock and gurnards ;² sailing vessels for the fish eaten by the rich, steamers for the food of the poor, which must be cheap and plentiful. The steamer fisheries are industrial by definition, and therefore we must take them chiefly into

¹ These figures are given by the French consular agent at Yarmouth.

² More widely eaten in France than in England, though an excellent fish. The reluctance of the retail seller to part with his fish at a low price per pound, and the huge head and capacious stomach of the gurnard, prevent its popularity in England.—[TRANS.]

account. To-day large quantities of merchandise are of more importance than quality. It is quantity that sets the market price, as the study of any large fish market, such as Boulogne or Grimsby, will convince you.

I will divide my description into three periods. The first period (the past), from 1808 to 1871, is characterised by the presence of sailing vessels only, and of low tonnage. The second period (transitional), from 1872 to 1900, is characterised by the introduction of steam fishing vessels among the sailing vessels, the latter being economically preponderant; and this period may be divided into two sub-periods: (*a*) from 1871 to 1894, marked by the first unfruitful trial of steamers; and (*b*) from 1895 to 1900, marked by the first successes of the steamers, and their regular establishment in the fishing ports. The third period (the steamer period), from 1901 to 1907, is characterised by the economic preponderance of the steam fishing boat. The table on pp. 270-1 gives the details of these three periods.¹

For each of these periods the corresponding average sale price of fish is given—£16, £13 11s. 2½d., £14 7s. 2½d.—by which it will be seen that the price for the third period is 6 per cent. greater than the price for the second period, so that steam trawling has not lowered prices.

In 1901 and 1902 a great many vessels were built. The yield of fish increased, and prices remained stationary; but the catch per boat decreased, on account of the crowding of the fishing-grounds. From 1902 to 1903 fewer boats were built and equipped; the owners appeared to hesitate. This did not prevent the yield from being tremendous. In view of this abundance, the price per ton decreased. Then, however, doubtless owing

¹ See pp. 270, 271.

THE NEIGHBOURHOOD OF BOULOGNE, 1808 TO 1907.

(Boulogne, Étaples, Le Portel, Équihen, Audresselles.)

(The catches landed at Boulogne represent 90 per cent. of the total catch of the entire district.)

Divisions.	Years.	Total Number of Boats fitted out (Sail and Steam).	Herring Boats of more than 100 Tons (Sail).	Increase of Steamers.		Tons of Fish Caught (Cod, Herring, Mackerel included).	Price of Fish per Ton.	Yield per Unit of Tonnage.	Observations relating to Steam Fishing Vessels, the Average Yield per Ton of Displacement, and the Average Price per Ton of Fish.
				Small Trawlers and Line Vessels.	Large Trawlers.				
1st Period (Past). Sailing vessels.	1808	100					£ s. d.	£ s. d.	Average yield per ton of vessel, £23 5s. 7d.
	1831	213						7 15 0	
	1871	268				21,669,633	16 0 0	15 8 4 46 13 4	
2nd Period (Transi- tion). Sailing vessels and experi- mental steam vessels.	1872								Line-fisher } Results Stuart ... } unsuc- Trawler Eurvin } cessful. Line-fisher Arc-en-Ciel, results satisfactory. Line-fisher Reine-Berthe, results unsatisfactory.
	1879				I				
	1881	272		I		31,109,787	13 8 0		
	1891	284		I		44,543,160	12 15 0		
	1892					41,522,720	11 3 5		
	1893		3			42,510,000	13 4 0		
	1894		3	6	2	41,684,860	11 0 9		First large trawler, <i>Ville de Boulogne</i> , successful.

1895 1896									39,969,000 50,937,000	15 8 9 11 16 0						Trawlers of 110 to 195 tons.
1897		4	14	2					39,664,000	14 10 5						Line-fishers of 20 to 50 tons.
1898		4	1	6					35,071,582	15 8 9						A petrol fishing boat (using lines).
1899		3	3	3					34,752,000	14 9 7						
1900		11	1	6				286	43,138,000	15 18 5			62 0 0			Average price per ton of fish, £13 11s. 2½d.
1901 1902	3rd Period (Steam). Sailing vessels & Steamers, the latter pre-dominating.	6	3 1	8 5				259 304	46,955,984 52,652,033	16 0 0 16 9 7			53 0 0 51 18 0			Trawlers of 250 tons.
1903 1904 1905 1906		3 2 2 2	3 3 7 7	2 5 8 12			239 213 240 243	70,264,938 58,210,534 68,048,351 70,469,477	11 16 0 13 12 0 14 4 0 14 2 5			53 14 0 56 13 9 41 9 7 39 10 0			Small trawlers and line-fishing vessels propelled by petrol motors.	
1907		3	3	12												Trawlers of 200 to 416 tons. Average yield per ton of vessel, £49 8s. od. Average price per ton of fish, £14 7s. 2½d.

3rd Period
(Steam).
Sailing
vessels
& Stea-
mers,
the
latter
pre-
domi-
nating.

to better technical methods and a lesser tonnage, the yield per unit of tonnage perceptibly increased. From 1903 to 1904, emboldened by the results of the previous year, many vessels were fitted out; and the curve of production swept downwards once more, while the sale price increased a little. The vessels being well exploited, the yield per ton also increased. From 1904 to 1905, in consequence, there was an increase of vessels. Fish were abundant; prices were hardly maintained. The curve of the yield per ton suddenly fell. In 1904 the sales were decreased by £60,000. The shipowners, frightened by the superabundance of herring and the fall in prices, agreed among themselves to reduce the number of their nets by a third and to fish only for five months in the year—from February 1 to July 1. From 1905 to 1906 still more vessels were fitted out. The curve of production gradually rises; prices remain stationary; the yield per ton increases slightly.

I have been drawn on to economic ground despite myself. Before abandoning it, I must refer to one delicate question relative to steam trawling. Should steam trawlers be of heavy tonnage, or small and light? It is obvious that the maximum yield of an otter-trawl coincides with the maximum opening of the net. Now, the maximum opening is determined by the width of the boards and the pull upon the warps—in other words, by the power and tonnage of the vessel. An immense otter-trawl drawn by too weak a vessel would be useless and dangerous. On the other hand, if the power of the vessel is equal to that of the huge trawl, calculation will show that the size of the catches will not be proportional to the expenses. The size of the trawler quickly approaches a limit which it must not surpass. What should the length be—200 feet or 240? No one knows;

but personally I think they should never exceed that size. Moreover, very large vessels should always work in distant and *excessively* abundant waters.

IV

We must not consider boats and gear and forget the men who work them. This last paragraph will deal with the profits of the fishermen, which must be expressed in terms of the total yield of the principal fishing-grounds.

The number of sea-going fishermen in France is about 100,000. Great Britain possesses about the same number. There is also, in France, a population of some 60,000 ashore—men, women, and children—actively engaged in the fishing industry. If we take the average figures of the season's fishery in France—namely, 191,600 tons of fish and £4,400,000—we find that each fisherman is responsible for an average of 2 tons of fish, each ton being worth about £22 16s. The profit per man, in round figures, is £46. The English fisherman produces considerably more. The total average catch amounts to 958,000 tons, worth £10,120,000. In other words, the English fisherman is responsible for an average annual catch of 9.58 tons of fish, each ton being worth about £10 11s. 2½d., so that the yield per man is roughly £101 per annum. In other words, the British fisherman catches nearly *five times as much* as the French fisherman, and, although he sells it at *less than half the price*, he gains more than *twice as much* as the French fisherman. As, like all industries and all branches of organised commerce, fishery is one of the forms of the universal striving for gold to assure the worker of food and drink, we may assert that the economic inferiority of the French fisherman arises from the defective organisation of the

French fisheries. The sea belongs to everyone ; it is not enough to know it, to be reared by generations of sea-going ancestors, to be cradled within sound of the sea and lulled by the murmur of its waves : the sea must be exploited as though it were a meadow, a field, a coal-pit, or a mine. Nature does not give ; she sells !

The sagacity and the good organisation of fishermen are reflected by the yield of the fishing-grounds ; for although it is obvious that the latter are productive in proportion to their richness, it is also certain that their productiveness is in proportion to the exploitation to which they are subjected.¹ Now, these two terms, you may remember, may be independent of one another, since there are still virgin grounds.

Below, reduced to the basis of the square mile, are the yields—we might say the harvests—of the Channel, the Atlantic, and the Mediterranean, as far as they may be calculated from the annual quantities of fish taken by French fishermen. The yield of the North Sea is calculated according to its total productiveness. The yield per square mile applies principally to bottom-fish ; but it may also be expressed in terms of bottom-fish and fish taken in the drift-net, supposing these latter to be precipitated on the bottom. The exploitable area of the Channel and the Atlantic continental plateau is taken as 28,490 square miles ; of the Mediterranean as 2,964 ; of the fishponds and estuaries of the Channel and Atlantic as 180 square miles ; of those of the Mediterranean as 335 ; and the area of the North Sea is taken as being 38,500 square miles, out of an actual area of 154,000. These data granted, we obtain, by calculation, the following figures :—

¹ See p. 190 *et seq.*

				Per Square Mile per Annum.
Channel and Atlantic (Continental Plateau).	{	Bottom-fish (trawl)	1'500 tons	
		Total taken from the fishing-grounds ¹	4'628	„
		Fishponds and estuaries	10'920	„
Mediterranean (Continental Plateau).	{	Bottom-fish (trawl)	1'011	„
		Total taken from the fishing-grounds...	2'340	„
		Fishponds and estuaries	5'668	„
North Sea (Continental Plateau).	{	Bottom-fish (trawl)	9'100	„
		Total taken from the fishing-grounds...	26'000	„

These figures, I need hardly say, have only a *very* roughly approximate value ; but they express differences so considerable that their comparison cannot but be instructive. The yield of the fishponds of Lümfjord, of the dammed pools, *valli*, fishponds, &c., can be arrived at with greater ease and exactitude. As this question has been dealt with earlier in the book, I beg the reader to refer to the figures there given.²

¹ Not in the open sea—*i.e.*, above great depths, but vertically above the bottoms which are fished.—[TRANS.]

² See Chapter VI., Part I.

CHAPTER VI

THE FISHING NATIONS AND THE GREAT FISHERIES

- I. Scotland and England—Germany—Denmark, Holland and Belgium—Norway, Spain, and Portugal—Italy and Russia—Canada and Japan—France. II. The French cod fisheries—Steam-trawling off Newfoundland. III. The sardine fishery of Brittany; fishermen, bait-sellers, manufacturers. IV. The herring fishery; the mackerel fishery; the tunny fishery.

THE progress of the French ocean fisheries is slow; for one step taken by the French the English take fifty and the Germans a hundred. All the nations of Northern Europe are strenuous exploiters of the sea. Norway, poor and infertile, has been forced from remotest antiquity to replace the plough by the net; and fishing has with her become the one great national industry. The miners of Wales and the Rühr, the English cord-makers, and the German metallurgists are the real makers of Hull, Grimsby, and Geestmünde; and who knows but the neighbourhood of the coal-mines of Pas-de-Calais and Flanders has contributed to make the prosperity of Boulogne? The activity of the fisheries seems to be bound up with the general industrial activity of the country. For instance, although the Spaniards, who are not an industrial people, eat largely of cod, they are obliged to import it, and confine themselves to the simple and easy capture of sardines.

I

The Orkneys and the Shetlands live wholly by the product of their fisheries. Lerwick, the principal town of the whole group of islands, contains a winter population of only 4,000 persons. In summer it is a hive of more than 16,000 individuals, who have come thither to catch and prepare the herring. In 1900 the little Scotch port of Buckie possessed three drifters: to-day it has nearly 150. With Fraserburg it has an annual output of 100,000 tons of herring, valued at £720,000. The revenues of the port of Aberdeen are sixty times as great as they were fourteen years ago; the steam trawler has made its home there. In 1887 the trawlers landed 400 tons of fish; in 1907, 88,000 tons. The production of Scotland has increased in astonishing proportions. Between 1898 and 1908 it has increased from 39,000 tons of bottom-fish to 103,000 tons, or from £440,000 to £1,000,000. Three years ago Scotland earned £2,980,000, as against £2,640,000 in the preceding year. Of this sum the herring stood for £1,640,000, as against £1,360,000 in the preceding year. The "Steam Herring Fleet, Ltd.," founded in 1899 with a capital of £90,000 in £1 shares, has paid its shareholders dividends of 22½ per cent.

The east coast of England takes the palm with its 1,700 steam drifters and trawlers, which, crowding into the ports like bees into a hive, throw more than 500,000 tons of fish annually upon the English markets, their value being roughly £6,400,000. The 100,000 tons of Yarmouth-Lowestoft herring sell for £1,000,000. The 600 trawlers of Grimsby bring up fortunes of over £3,000,000 annually from the floor of the sea. It is not uncommon, at the Fish Dock, to see 250 to 400

trucks loaded with fresh fish, representing a weight of 1,000 to 1,200 tons.¹ The Hull fleet, as the reader will remember, is nearly always at sea—many of the vessels plying to the Iceland banks—convoyed by the “runners,” four or five of which leave the fleet every day, arriving at Billingsgate in the morning full of prime fish,² the total amounting to nearly 50,000 tons per annum. North Shields and Hartlepool feed the Black Country. The graceful sailing vessels of Lowestoft work across the banks of the Sole Pit, bringing in an annual harvest of 12,000 tons of turbot, brill, and soles; these working for the *gourmets*, while trawlers and drifters work for the people.

The German herring fisheries have gone from increase to increase. In 1900 the 118 German herring boats furnished 14,000 tons, worth £180,000; last year 270 boats yielded 51,000 tons of herring and £520,000. Fourteen companies are engaged in this fishery. During the decennial period 1898–1908 the port of Geestmünde doubled its output of prime fish: 14,000 tons, worth £160,000—30,100 tons, worth £320,000; but it suffers slightly from the competition of Cuxhaven. The powerful company established at Nordenham, the “Deutsche Dampffischerie Gesellschaft Nord See,” owns fifty trawlers. It was founded on April 23, 1896, with a capital of 3 million marks (£150,000), which was quickly increased to 4 millions by a loan on mortgage, and in 1907 to 5 millions, to which 2 millions have been added in shares, making in all 7 millions (£350,000).

¹ In 1902, Grimsby had 430 trawlers; to-day they number close upon 600. Annual yield: prime fish, 150,000 tons (a third of the total English production); herring, 15,000 tons; mackerel-sprats 1,500 tons.

² See last chapter.

The dividends oscillate between 8 per cent. and 12 per cent. The company owns a depôt for fitting-out at Huelva and branches at Basle and Budapest.

The value of the fish taken in the German Baltic amounts to £300,000 or £350,000; the species include plaice, gurnard, herring, salmon, turbot, flounders, and sprats, which find their way to the markets of Dantzic, Königsberg, and especially Stettin. In Denmark, the motor-boat and the plaice are triumphant.¹ In Holland, the great port of Ijmuiden has absorbed the trade in fresh fish. During the last twelve years twenty trawler companies have been established there, and the annual harvest exceeds 40,000 tons.² Not far from Ijmuiden, Ostend makes no progress, owing to her poor equipment. Despite an increase in tonnage, the sales have diminished by 4 per cent. in less than a year.

The 25,000 fishing vessels of Norway fish the coastal waters. The great harbour of Aalesund equips 90 steamers and 330 motor-boats, and is a great centre of the dried cod or stock-fish trade: cod from the Lofodens, cod from the North Sea, cod from the Arctic Ocean. Bergen and Stavanger send out 3,000 to 4,000 undecked boats and only 50 steamers. They catch and prepare sprats, sold as Norwegian anchovies and sardines. Herring are caught all along the Norwegian coast. There are large fish markets—especially for salmon—in all the coast towns, from Arendal in the south to Vadsö in the north—at Stavanger, Bergen, Christiansund, Trondhjem, Tromsö, Hammerfest. From 1899 to 1905 the Norwegian fisheries remained stationary,

¹ See pp. 124, 299, 300.

² The French Consul informs us that this year the fisheries of Holland have remained stationary. But the herring fishery yielded 804,120 barrels as against 685,662 in the previous year.

their annual value being about £1,920,000; but at present they produce over £2,400,000. This sum is exclusive of the yield of the whale fishery and the sales of by-products, which amount to some £200,000 or £240,000.

The northern nations hold the supremacy in the matter of fisheries; but the movement seems to be creeping southwards. Since 1904 a score of trawlers have established themselves at La Corogne, where they engage in the hake fishery. There is talk of establishing fisheries at Barcelona, together with a stock-fish and a fish-manure factory. The little harbour of Marin shelters forty *cordiers*, or line-fishers, which take gilt-heads, gurnard, and conger. With Vigo, Marin is the centre of the sardine fishery. The Spaniards, like the French Basques, catch sardines with the seine. Vigo exports more than 4,000 tons of sardines in oil. There are 137 factories in Vigo; and ten prepared sardines are worth rather less than three-tenths of a penny—that is, less than the box that holds them and the oil that preserves them. The principal Portuguese sardine port, Setubal, fishes with a kind of seine or “circle”^{*} or with *madragues*; and the yield of 13 “circles” supplies 37 factories. Lisbon sends sailing vessels to Newfoundland. From the mouth of the Minho to Cap Sines the crayfish or spiny lobster abounds. This stretch of coast, together with the neighbourhood of Sorlingues and the banks of Cape Blanco, are a fishing-ground often frequented by French fishermen. The fishermen of southern Italy engage in the tunny fishery, using the *madrague*. Those of the Adriatic use the net, line, and the hand-seine,

^{*} The Portuguese “circle” is 530 yards long and 36 yards in depth; the mesh is $\frac{1}{6}$ of an inch. A “circle” will sometimes take 2 million sardine in a single catch. The net costs about £1,000.

and preserve fish in the lagoons.¹ A limited company has recently been formed at Ravenna with the object of leasing the fish-bearing lagoons and sub-letting them to shareholders. The most important Russian fisheries are those of the Black Sea and the Caspian, where sturgeon, shad, and herring are taken. There are preserving factories at Odessa, Balaklava, Otchakow, Kertch, and Theodosia. The Sapojnikoff factories were founded in Astrakhan in 1796. The sturgeon, bream, carp, and herring of the estuary of the Volga are the object of an active fishery, which is closed from the 15th May to the 15th July. Once landed, the fish are cleaned and cut up by a staff of 4,000 workmen.

Leaving Europe, let us consider the fisheries of Canada and Japan. The Canadian fisheries are among the most important in the world. Their annual yield is worth £4,200,000. Salmon, lobsters, cod and herring do most to make up this enormous sum; then come mackerel, flounders, and whitefish. In Japan steam-trawling is in its infancy. Nearly all the fishermen use small boats—there were lately no less than 200,000. From the coast fisheries, from around their islands, from the banks of Korea, from the Saghalien and Kamtschatka, the Japanese derive from £5,200,000 to £5,600,000 annually; mostly from the sale of sardines and gilt-heads. The overflowing energy of the Japanese is now being directed to the modern aspects of fishery. After the war with Russia 40,000,000 yen were devoted to the establishment of fishery companies.

The French fisheries, during the course of the nineteenth century, have steadily augmented.² Between 1810

¹ See p. 136.

² Here are the *average* figures of the French fishery harvest: cod, £720,000; herring, £560,000; sardines, anchovies, sprats,

and 1860 they increased by £880,000 : from £440,000 in 1810 to £1,320,000 in 1860. Eight years later they had doubled ; in 1875 they had reached £2,980,000 ; in 1880 £3,480,000 ; in 1890 £4,280,000. Then they declined somewhat, but in 1902 rose once again to £4,160,000, and to-day amount to some £4,800,000. In short, the fisheries of France are of nearly the same market value as those of Japan or Canada. They represent a capital of £4,000,000 ; £1,000,000 representing gear, the rest the boats. Some ports are prospering, as Boulogne, Fécamp, and Arcachon ; some are stagnating, as Calais,¹ Saint-Malo, Paimpol, Douarnenez, Les Sables, &c. ; still more are in a state of decadence, as Dunkirk, Dieppe, Honfleur. In the Boulogne district, which includes the five ports of Boulogne, Étaples, Le Portel, Equihen, and Audresselles, the value of the fisheries has increased by £400,000 between 1896 and 1906. The annual share of Boulogne in the fisheries of France is nearly one-fifth—19 per cent., or £960,000 ; almost a million. Fécamp makes £320,000 to £360,000, Arcachon £280,000 to £320,000.

II

I shall not attempt to give, in a few pages, any account of the condition of the French fisheries, for I should be attempting the impossible ; but I should

£880,000 ; mackerel, £200,000 ; tunny, £240,000 ; hand-seining, fishponds, trap-nets, &c.—flat-fish, fish caught in the beam-trawl and especially in the otter-trawl (steam trawls)—hake, gurnards, codling, &c., £2,000,000 ; oysters, £80,000 ; mussels, £80,000 ; other shell-fish, £80,000 ; shrimps and prawns, £60,000. Marine manures, iodine, &c., yield about £240,000.

¹ There is now (December, 1910) a perceptible recovery of business in this port.

be guilty of a serious omission if I did not give the essential facts concerning them.

The cod fishery, like all fisheries, is irregular. Year in, year out, it yields the French fishermen about £720,000, oil and roe included; Iceland counting for £280,000, the Dogger Bank for £20,000, and Newfoundland for £420,000.

During the last ten years the Iceland fishery has absorbed fewer vessels and a less tonnage. The causes of this diminution are many. I will mention only two : the increased wages of the crews¹ and the first unfruitful essays of the steam trawlers. The evolution of the Icelandic fishery was a trifle sudden. The fishermen, apt by hereditary custom in the handling of lines, knew nothing whatever about the otter-trawl, and the ordinary trawler's crew knew nothing of the habits of the cod. Unfortunately, too, in 1907 and 1908 the fish kept close inshore, inside the territorial limit, where supervision, based upon strict legislation, is almost unsleeping. The Icelandic Parliament had claimed the right to prohibit all steam trawlers even from entering or re-victualling in territorial waters. The previous year the schooner fleet did especially well—as well as before the appearance of the trawlers. However, these trawlers, especially those from Fécamp, made very large catches at the opening of the campaign. This year, in general, they have succeeded. It would seem that they are henceforth an established fact, and an old captain of long-distance fishing boats told me last October that they had conquered the Icelandic banks. English and German shipowners were more quickly convinced, for their trawlers grow more and more numerous.

¹ See pp. 252-3.

The situation in Newfoundland is more complicated than in Iceland. The question of the steam trawler is there involved with another question, which affects only the sailing vessels: the matter of bait. The cost of bait is for them the cost of fishing. It has to be obtained on the spot, for the fishermen take none with them on leaving France, beyond perhaps a dozen barrels of salted herring, and they count upon abundant harvests of *bulots*, *encornets*, and caplin to bait their hooks during the first fishing season. Here we recognise the proverbial imprudence of seamen. To-day the question of bait is partly solved; a refrigerating storehouse has been built at Saint-Pierre, for the preservation of *bulots*, *encornets*, and caplin, where the Breton and Norman "bankers" can in future lay in supplies.

In 1908 the French trawlers did well. There were twelve: hailing from Boulogne, Fécamp, and Arcachon. The *Nord-caper*, in thirty-six days, caught 4,000 quintals of cod; the *Marguerite-Marie* caught 1,500 in sixteen days. All these trawlers fished the Banquereau, the largest catches being made on its eastern portion, in depths of 22 to 27 fathoms. "These results," wrote the commandant of the French naval station of Newfoundland, "are greatly superior to those obtained in the Iceland fishery. From the declarations of four captains who had fished off Iceland before coming to the banks, it appears that the average yield of the Iceland grounds did not exceed 50 quintals per diem, or less than half of the yield obtained here. Moreover, the daily catch there is far less regular than here, and the fishery proceeds, so to speak, by fits and starts, in the intervals of which the crew does nothing, which is not the case here. It is expected that next year a large proportion of the fifty French trawlers which

usually fish in Icelandic waters will only make their first voyage or so thither—the most profitable, as the results are sold in France during Lent—and will then come to the Newfoundland banks. This, of course, applies only to such vessels as can carry sufficient coal for the voyage across the Atlantic; that is, those which can carry at least 100 or 120 tons of fuel." This prophecy was correct; last year twenty-two large French trawlers fished the banks. This year the results have been positively brilliant. Yet the increased tonnage of large trawlers increases their working expenses without increasing their captures in the same proportion, so that some shipowners are asking if it would not be better to equip small steam trawlers, which would spend the greater part of the year on the banks, employed solely in fishing, not in fishing and then transporting their captures to France.

The Newfoundland fishery extends not only over the banks, but also along the old French shore, which is French no longer, since the Anglo-French agreement of April 8, 1906, along the east coast, in the creeks of Saint-Pierre and Miquelon, and in the estuary of the Saint Lawrence.

Four or five years ago it was hoped that a great part of the Newfoundland fleet might be sent instead to the Baie du Lévrier, in Morocco. Experience, however, has shown that the two regions are so fundamentally diverse that one could not expect them to yield the same products. The Baie du Lévrier, and almost the whole area of the Atlanto-Saharan banks, supports stupendous quantities of fish, but no true cod. All kinds of fish swarm there, and nearly all the species found there are found in plenty: bastard mackerel, tunny, mullet, bar, rays, &c.

III

Except for the inevitable disputes between employers and employed, the cod fishery is a peaceable industry. Such has not been the fate of the sardine, which has aroused the most violent passions. So much has been written concerning the sardine fishery in Brittany that I will leave the matter alone ; everything has been said, and I come too late. Yet one may always repeat what others have said ; not much would be written if one did not !

The sardine question has four aspects. Firstly, we must consider the fishery itself ; secondly, the relations between the fishermen and the bait-merchants ; thirdly, the relations between the fishermen and the manufacturers ; fourthly, the relations between the manufacturers and the packers or solderers. These four aspects, or, shall we say ? series of relations, are inextricably connected ; that is, if a dispute occurs between two parties of any one pair, the whole organisation is more or less badly dislocated. In the case of the cod fishery, the shipowners are capitalists, dealing as such with their crews ; in the sardine fisheries of the Breton coast there are no owners, or rather the fishermen themselves are the owners, and are workers on the share system. This distinction is fraught with important consequences.

From Camaret to Sables-d'Olonne there is practically no fishery but the sardine fishery. Now the sardine harvest, with the methods at present in use, is extremely irregular. In 1894 it amounted to 11,000 tons ; in 1898 it rose to 51,000 tons, and immediately afterwards fell to 25,000 ; in 1902 it had fallen to 8,000 tons. In 1904 it rose again to 23,000 tons, and in 1907 fell to 3,000. From these fluctuations continual disorder results :

when there are no sardines the result is poverty for the fishermen, who have nothing to sell; when there are too many the result is poverty for the fishermen, who sell at a wretched price and fail to cover their expenses. The recent disturbances at Douarnenez, which led to the military occupation of the town in September, 1909, had no other origin than this irregularity. The fishery was too good; the manufacturers, whose warehouses were overstocked, were unable to buy the fish, and the fishermen were forced to throw it into the sea.

If the equipment of the sardine sloops or cutters were merely a matter of buying nets and sails, the losses, heavy though they might be, would be less crushing; but the Breton fisherman knows nothing of fishing without bait. The bait employed—*rogue*, or salted cod's roe—is unfortunately very dear, costing £3 16s. to £5 4s. the barrel, and the fisherman must have at least a barrel per week. As he is poor, he is often charged excessive prices; we have heard of corners in *rogue*, of speculations of which the unfortunate fisherman is always the victim.

He, again, is the first victim when a dispute occurs with the manufacturers. Of this fact the trouble at Douarnenez affords an excellent example. After a month of restlessness and turmoil, the manufacturers and the fishermen signed a definite agreement on October 14th, to the following effect: "Each boat shall take not more than 8,000 sardines; the minimum sale price shall be 7 francs per thousand; and the manufacturers undertake to do their utmost to take the total catch up to the number of 3,500,000 sardines." Now, M. Pérard has clearly shown that a master-fisherman who sells his thousand for 7 francs only just covers his

expenses. He cannot exist under such conditions as these.

The manufacturers, on their side, are at grips with their solderers or packers. If the catch is poor they dismiss them; if it is too heavy they talk of installing machinery to close and solder the boxes. In either case trouble is inevitable. Consider the strike of the solderers at Concarneau in July, 1909. It was only under the protection of troops that the manufacturers were able to install machinery in some of the factories.

"The solderers," wrote M. Pérard, "then tried to win over the fishermen, endeavouring to make them promise that they would refuse to deliver fish at any factory in which the machines were installed." "If we are beaten to-day," said the solderers, "you fishermen will be beaten to-morrow." The fishermen, in order to keep up the prices and avoid glutting the market, decided "at a public meeting not to put to sea more than once a day and to remain ashore on Sundays." The manufacturers begged them not to carry out their proposal; but the fishermen, considering themselves aggrieved, joined the solderers and pillaged the factories. Such conflicts are bad for everyone: the fishermen and solderers, who, whatever they may do, will sooner or later be conquered by machinery, are thrown out of work, and the manufacturers are unable to compete with their Spanish, Portuguese, Norwegian, and Japanese rivals.

As we see, the sardine problem is too complicated for haphazard solution. To limit the number of fish thrown on the market does not affect the fundamental facts. The only solution lies in regularising production, and this is impossible without a radical alteration of the methods of fishery employed. The Breton fishermen, like the Danes and the Arcachonese, must replace their

poor little cutters by motor-boats. For many years the tunny fishers and the crews of trading vessels have testified to the presence of sardines in the open sea, even where none are to be found along the coast. The obvious thing is to go in search of them. In the time of sailing boats the sardine fisheries of Arcachon barely existed. It is the motor-boat that has made the industry prosper—the motor-boat, manned as a rule by men who had no seafaring traditions, who were not even seamen, but who, in spite of that fact, or because of it, resolutely made daily trips of thirty to forty miles out to sea in search of the sardine. Nor is this all. It has been proved a score of times to the Breton fishermen that they can fish without *rogue*. M. Fabre-Domergue himself, in August, 1907, conducted some decisive experiments before their eyes in the straits of Groix ; using a Guézennec seine, he took at one haul 1,200 anchovies and 2,000 sardines, while the fishermen round about, who were of course using *rogue* for bait, took nothing at all. Next day the seine was destroyed by the crew of a Concarneau boat ! Every time seines have been used they have come to the same end : the Breton fishermen will not stomach them at any price. There are 23,000 fishermen concentrated round Camaret and Les Sables d'Olonne ; and 1,500 workmen, without counting the women and girls who work in the factories or the labourers. They form, with their families, a population of 200,000 persons, and they do nothing and wish to do nothing but engage in a single fishery and live by a single fishery : namely, the sardine fishery. The truth is, *they are too many and the fish are too few*. They are stifled by their own numbers : every attempt at progress is doomed to futility. One is tempted to compare them to the fish they capture ; to those banks

of sardines to which a superabundance of individuals is a perpetual danger. Nothing is more harmful to any given district than the practice of a unique industry. The Breton fishermen are in somewhat the same position as the wine-growers of the Midi.

May the day soon come when, selection having preserved the fittest among the sardine fishers, the motor-boat and seine when the fish are rare, or the motor-boat and the baited net when the fish are abundant, will return to port every morning with its catch of sardines ; when the division of labour shall have relieved the congestion of the coast by the introduction of tunny, crayfish, and bottom-fish fisheries, and the exportation of sardines both in the fresh and preserved state. Then the embittered crises of to-day will disappear, and with them poverty.

IV

Although the herring is a close relation of the sardine, the herring fishery is a peaceable industry. To be frank, it has grown peaceable with age ; for its annals are flecked with human blood. The reader must remember that all during the Middle Ages the herring trade was of the utmost importance, for the armies of those days were largely fed on herrings. For centuries this trade was the direct cause of sullen conflicts between the English, Dutch, German and Danish merchants. In 1348, the Danes having imposed a customs duty upon all foreign herrings, the Hanseatic cities immediately declared war upon them. . . . But I will pass in silence over the innumerable wrangles for which the herring is responsible. There is no "herring question" to-day ; it is enough for me briefly to describe the herring fishery.

Fécamp and Boulogne produce an annual harvest of 700,000 quintals of herring ; about one-tenth of the

entire production of Europe, and worth from £480,000 to £600,000. The herring fishery is divided into three seasons : the Scotch season, the Yarmouth season, and the autumn season. The Scotch is the summer season, and lasts three months : through June, July, and August. The drifters of Boulogne and Fécamp shoot their nets to the east of the Shetlands and the Orkneys, and to the north and east of the Scotch coast. As the temperature falls they work further south. By the middle of September they are opposite Spurn Head ; there the Yarmouth fishery commences. Five weeks later they are in the neighbourhood of the Channel ; this is the autumn or Channel fishery, which is carried on regularly between Dunkirk and Barfleur from the last week in October to the end of February. There is not a bay, cove, or estuary into which the fish are not pursued.

During the first two seasons, the Scotch and Yarmouth seasons, the fish are salted or frozen. The salted herring is salted in bulk (*braillé en vrac*), or thrown pell-mell, mixed with salt, into the hold ; or it is known as white herring when salted in barrels directly it is caught. It is sold in that state or reserved for smoking. Of the autumn herring a good half is consumed in the ports or despatched as fresh herring. The rest is usually bought by the curers. A last consists of 12,000 herrings ; the barrel weighs 220 lbs. and contains 800 to 1,200 fish.

The mackerel fishery is, so to speak, the younger sister of the herring fishery. There are two seasons : from April to June the herring boats shoot their nets in the Irish Sea ; then, as the season advances, they double back to the Channel ; in August they are off the French coast. During the month of October there are still large shoals of mackerel at sea off Start Point, and the French trawlers bring back abundant cargoes. Like the herring,

the mackerel is sold in France either fresh, salted, or smoked. The annual catch weighs from 13,000 to 15,000 tons, and brings in from £120,000 to £160,000.

Another of the Scombridæ, the tunny, is the object of a lucrative fishery in the Atlantic and the Mediterranean. The Atlantic tunny, or white tunny, or germon, is taken in the Bay of Biscay, beyond the course of the steamers running from Ushant past Cape Finistère. It weighs from 45 to 65 lbs. ; its flesh, which is extremely white, is admirably adapted for canning. All the summer through the fishermen of Groix, Croisic, the Ile d'Yeu, Les Sables-d'Olonne, and La Rochelle keep the sea, often for weeks together, catching the white tunny with their lines. The boats work in groups of four or five, and one of them in rotation carries the catch to the factories ashore, where the fish is sold in lots of twelve. The total value of the fishery is over £280,000. In the Mediterranean the tunny is a gigantic fish of a different species, its flesh being rose-coloured, its weight running from 160 to 330 lbs., and its length from 5 to 6 feet. It is taken with the harpoon or with the *courantille*, a huge net in which the fish struggles, so causing the net to fold over it and imprison it, or the *seinche*, a kind of seine which completely encloses the shoal,¹ or, above all, by the *madrague*. The fishery is not very flourishing. For 4,000 tons of the Atlantic tunny, scarcely 600 tons are caught in the Mediterranean. The *thonaires* of Tunis are large establishments, each of which comprises, besides the vast *madrague*, a factory for canning the fish, preserved in oil, and for the preparation of by-products. For some

¹ The shoal is imprisoned by a net drawn underneath it as well as around it as by a huge "tuck-net." The *seinche* is drawn in until the shoal is entirely surrounded by the heavy boats, into which the fish are lifted by the harpooners.—[TRANS.]

years the yield of the *madragues* of Languedoc and Provence has been decreasing, but not that of the seines and *courantilles*. The tunny fishery might well be stimulated by means of swift and handy vessels which would fall upon the shoals of tunny in the open sea.

Here I must close this rapid sketch of the fisheries of France. We have learned from it that the fisherman, left to himself, was the prisoner of his social inheritance no less than of his present poverty, and that he could not unaided cross the narrow limits of the primitive œcumene.

CHAPTER VII

THE EVOLUTION OF THE FRENCH FISHERIES

- I. History of the steam fishing boat—Sail *versus* steam—The naval inscripts and the capitalists. II. The defence of steam ; its triumph. III. History of the motor-boat as applied to fishery—Its progress abroad and in France—The old types of boats and motors—New types. IV. Alcohol or petrol ?—The two principles criticised. V. The principal consequences of mechanical fishery. VI. The steam-trawling crisis.

THE crisis of steam-trawling and of mechanical gear in general is not yet over. It has only changed its aspect. The late struggle to perfect the methods of fishery is succeeded by the struggle to give the new methods the fullest scope. In this chapter I will consider both aspects of the question.¹

I

The steam fishing boat had its birth in France, about the year 1865. At that period the "Ocean Fisheries Company" (*Société des Pêcheries de l'Océan*) built two small trawlers. In 1872 M. Joseph Huret, of Boulogne, built the *Stuart*, a wooden vessel equipped for the herring and mackerel fishery. This vessel was 63 feet in length. Although the experiment was not successful, a second trawler was launched seven years later, the *Eurvin*, an iron

¹ A large part of this chapter appeared in the *Ligue maritime française* (March-April, 1909 ; May-June, 1910).

vessel this time, its tonnage being 176. About the same time the first steam line-fishing vessel, the *Arc-en-ciel*, was launched. Early in 1881 Boulogne made a fourth attempt, and the little trawler *Reine Berthe* was launched. Then a Marseilles company, the *Marée des Deux Mondes*, despatched its great steamer, the *Stella Maris*, a vessel of 1,400 tons, equipped with refrigerating chambers on the Carré system, to fish the waters between the Canaries and Senegal. Then Great Britain, followed by Germany, adopted the steam fishing boat. In 1890 Arcachon possessed five steamers: the *Héron*, *Cormoran*, *Pingouin*, *Pétrel*, and *Courlis*. Boulogne, however, was the first port to produce—in the shape of the *Ville de Boulogne*, a steamer of 195 tons, launched at the end of 1894—a vessel making catches comparable to those of to-day, and the first European steamer equipped for all kinds of fishery: for trawling as well as for the herring and mackerel fishery. The two Dutch fishing-boats which followed the *Ville de Boulogne* were built on the same model. The necessary impulse had been given; steam-trawling was at last practicable, but it had yet to win its spurs.

To win them cost it dear. Nothing was left undone that might hinder the development of trawling on the grand scale. The Congress of Saint-Brieuc demanded the abolition of the otter-trawl. In 1898 the fishermen of almost the entire Atlantic coast addressed a vigorous protest to the Ministry of Marine. In the same year the fishermen of Trouville pillaged the cargo of a steam trawler. M. de Lamarzelle, senator for Morbihan, in his speech of May 20, 1899, expounded from the tribune the grievances of the Breton fishermen; the latter, the majority of whom owned their boats, could no longer struggle against the large shipowners; the otter-trawl was flooding the markets with enormous quantities of

fish, prices were falling, the fishing-grounds were being emptied of their fish, and many fishermen were out of employment. The Congress of Douarnenez claimed the exclusive monopoly of the fisheries for the naval inscript. "The right of fishery," it declared, "is reserved in favour of the naval inscripts, and it is merely in virtue of an unjustified tolerance that the trawler companies, formed by capitalists, are plying their industry." M. Lamy, deputy for Lorient, proposed a law which would impose a due of 10 fr. (8s.) per ton upon all steam trawlers. The men of Royan were shocked at the idea that a steamer "manned by 14 men can compete in earning power with 80 to 100 sailing vessels manned with 600 or 700 fishermen." Only two years ago the Congress of Breton Inscripts demanded that access to the smaller ports should be denied to the trawlers, "which land too much fish and cut the nets of the fishermen with their screws."

II

These few details show us that man is an unchanging animal. Long ago the boatmen of the Weser smashed the steamboat of Denis Papin, and the weavers of Lyons destroyed the mechanical looms of Jacquard. The Dutch in 1800 and the English in 1853 violently demanded the suppression of the simple beam-trawl. To-day the fishermen of France are still fighting against the introduction of modern gear. It is the eternal struggle of the coach and the railroad.

If the attack was violent, so was the defence. M. Lockroy, then Minister of the Marine, disposed of the objections of the senator Lamarzelle. But the backbone of the attack was M. Lamy's proposed law; once voted, there would be an end of steam-trawling. The Com-

mittee (*Commission*) of the Marine of the Chamber of Deputies requested the advice of the Central Committee of the Shipowners of France and the Consultative Committee of Maritime Fisheries. Their advice was unfavourable to M. Lamy's proposal. "Steam-trawling," said the two committees, "must be encouraged. The steam trawler does not enter into competition with sailing vessels. The large steam trawlers work in the open sea, at a depth of 28 to 110 fathoms, and only capture adult fish, on account of the large size of the mesh employed: whereas the small fishermen always work in-shore, and thus destroy the reserves of fry and young fish, a destruction by which no one profits. Secondly, the enormous quantities of fish landed by the steam trawlers, so far from lowering prices, actually increase them. This is proved by the statistics prepared by the 'Syndicat des armateurs de pêche de Boulogne,' which show that the market prices of fish have undergone an average augmentation of 26·47 per cent. since the introduction of steam-trawling." Certain shipowners, on the other hand, particularly those of Dieppe, went so far as to demand that the maritime authorities should force all fishermen to keep the provisions of the law of 1838, which forbade them to fish during the summer in the estuaries or on sand-banks.

Let us consider the remarkable defence of steam-trawling published by M. Daniel Bellett. "It is perfectly well known," writes the eminent professor, "by all those who have made a study of the facts of economics, that the development of machinery benefits everyone, producers as well as consumers. The advent of steam trawlers has resulted in the payment of comparatively high wages to fishermen who were miserably vegetating on board their sailing vessels, as is only natural, when we

consider the greater yield of this method of fishery ; and at the same time the steamers ensure a much greater measure of safety than the sailing vessels. . . . The advent of the new method of fishery affords a fruitful occupation to the men who found it difficult to obtain a profitable engagement ; and if the proposed dues were voted the owners of the trawlers would be forced, as they have stated, to reduce their crews, which reduction would press hardly upon their inscripts. The latter perhaps grudge the capital invested in these steam-fishery undertakings because it is not their own ; but ought they not to be thankful to see capital come their way at all ? In the strict letter of the law the capitalists are encroaching upon the privileged domain of the inscripts. It would be only common sense to demand the suppression of this privilege, together with all the antiquated legislation which surrounds and restricts them ; and let them beware lest the capitalists, who were so badly treated at the Congress of Douarnenez, withdraw from an industry which was already decaying precisely because it had so little capital at its command."

This campaign bore fruit. The *Commission de la Marine* of the Chamber of Deputies decided to go no further with M. Lamy's proposition, which did not fare well in the debate. From that time forward it was possible to exploit fishing-grounds far removed from French or even from European waters ; to conquer new submarine regions, and to despatch therefrom, rapidly and in good condition, large quantities of fish.

Steam-fishery had won its case. But the victory was late and bitterly contested, and was therefore less of a victory : for in matters of economics delay is the worst of misfortunes. While the French inscripts were fruitlessly opposing the shipowners and paralysing the sources of

the new industry, their neighbours across the Channel and beyond the Rhine, assisted by their Governments, were unremittingly building fresh steam trawlers and selling their sailing boats, which they had no longer much use for, at a bargain to the French. Before the year 1900 there were hardly a hundred steam trawlers in France, and of these 20 were at Boulogne and 25 at Arcachon. In November, 1907, their number had increased to 200, while Great Britain possessed 1,000 and Germany 500. On January 1, 1908, there were 214 trawlers and 33 line-fishing vessels. Between May, 1908, and March, 1909, 16 steam trawlers were launched, 9 from English yards; while 1 was bought from abroad and 5 sold, one of them to Italy. The impulse was given; unfortunately it has not lasted.¹

III

Thanks to the victory of its forerunner, the steam fishing boat, the petrol boat quickly found a place. Nature would seem to have given steam the part of a conqueror, and it was the same with the railways as with the large steam trawlers: what struggles against preconceived ideas, traditions, and interests, before the first steam automobiles were free to travel the roads! About 1902, two shipowners of Boulogne began to build a "mixed" herring boat, the *Jean*. Since then the number of herring boats, small trawlers and line-fishers has continually increased. Trouville and Port-en-Bessin boast of several motor-cutters. The crayfish catchers have adopted the motor; and a few of the tunny boats of Groix and two or three shrimp-trawlers are propelled by petrol. Scarcely three years ago the men of Gujan-Mestras, Audenge, and Andernos used to hoist their sails at dawn, or when there

¹ See p. 308.

was no wind would get out the sweeps, and with much labour contrive to get to sea, there to catch sardines. A petrol boat appeared : the example was contagious. To-day we behold a perfect swarm of boats—not precisely uniform in size or shape—in which every known make of motor has found a resting-place. This rain of motors was like a thunder-shower, however : it did not cover any great extent of coast.¹ Such favours, which do not come from heaven, are reserved for other countries.

Denmark possesses more than 700 *bouticlars* (luggers or dandy-rigged), all driven by petrol. The west coast of Scotland has in eighteen months launched a score of large motor-boats 30 feet in length, of the type known as Loch Fyne skiffs. The east coast, after much hesitation, has fitted propellers to a number of boats of the Zulu type. In Germany, five years (1903-8) have enabled the well-known company, the *Seefischerie Verein*, to make the use of the motor known to the fishermen of the Elbe. The 100,000 Sicilians established in Boston, U.S.A., most of whom are fishermen, have fitted their dories with alcohol motors.

Seven hundred motor-boats in Denmark ; 307 in France. The comparison is eloquent, and the programme before us is clear. Firstly, we must persuade our fishermen to transform their present sailing boats into auxiliary motor-boats ; secondly, we must build motor-boats. You may ask, Who will furnish the money ? In default of capitalists, why not the *Crédit Maritime*, at all events for the present ? I will simply say here that all true friends of the fisherman are agreed on this point.

According to competent advisers, such as M. Marcel Grenié, director of the shipyards of the Garonne, it would

¹ There are now (December, 1910) a number of motor-cutters, at Port-Louis.

be an easy matter to fit a propeller to a Breton cutter. "The Vendéean cutter, 33 feet long, 9 or 10 feet wide, 24 to 26 feet on the keel, drawing 5 or 6 feet, could be still more readily fitted with a motor. The sternpost could be perforated without danger, and space for the screw could easily be found between the keel and the rudder. For that matter there is no reason why a lateral screw¹ should not be fitted if preferred, as in the Breton cutter. A motor of 15 or 18 h.p. would give a speed of 6 or 7 knots. The expense would depend on the power and value of the motor. It would vary, according to the case in point, from £120 to £240 per vessel." Two years ago a Dunkirk builder, M. Trézel, had great success with such transformations.

As for new motor-boats, whether full-powered or auxiliary, it would seem prudent for the present to be content with building the smaller types: dinghies, cutters, luggers, and yawls or ketches. So far this programme has been adhered to. With the exception of the *Langouste*, a schooner with live-holds (perforated; allowing the sea-water free access), the largest motor-boats—such as the *Marcelle* and *Simonne*, of Dunkirk, the *Jean*, of Boulogne, the *Oliah*, of Cayeux, the *Araock*, of Camaret, the *Aventurier*, of Audierne, and the *Va de l'Avant*, of Groix—have not exceeded 98 feet in length. The Ecolin cutters are 33 feet in length; those of Port-en-Bessin from 50 to 56 feet; the "Pornicais," or Pornic boats, 36 feet; the larger of the Arcachon motor-

¹ M. Grenié probably means a screw with the shaft-blocks bolted beside or below the sternpost. The method of perforation is preferable, as the sternpost or deadwood can easily be strengthened by means of battens or plates of brass. I have seen many English smacks so treated, also old pilot-boats. The cost quoted is very greatly in excess of anything that need be paid in this country.—[TRANS.]

boats 46 feet ; and the decked cutters of Cape Breton 41 feet.

I cannot go deeply into the question of the construction of new motor-boats ; at the same time, the problem, as I see it, is simple enough. The various types of fishing boat are, as I have said, local products—regional products, to use the term ; they answer certain given requirements ; they correspond to local methods, local traditions. Time has selected them, and they have survived its criticism. It is therefore only reasonable to preserve these forms, only fitting them with motors. This has nearly always been done.¹ It was sufficient to round the lines of the “Ewers” of the Elbe, and to carry the section of greatest beam a little aft, to make excellent motor-boats of these ancient vessels. One of the largest “dandies” of the Pomeranian coast, the *Memel*, built in 1903 especially to receive a motor, is merely a copy of the old Danish “kutter.” During a long journey in Scandinavia I was struck with the ease with which the old Viking types (which we find slightly altered in the Seine estuary, as is only natural) carried their heavy petrol motors. When automobile fishery was introduced in the Arcachon lagoon, it never occurred to any one to desert the familiar “pinnaces.” Must we conclude from this that all reforms must be proscribed ? By no means ; on the contrary, we must encourage the builders to introduce such improvements as they think necessary.² Last

¹ The specially shaped “slipper” boats and other new types make very poor weather, and most of them waste power in raising enormous “wakes.” I have often, on the other hand, been struck with the unlooked-for speed obtained from quite a small motor fitted to a good type of fishing boat or pilot-cutter.—[TRANS.]

² As the fishing boat must carry a heavy load, be roomy within, and make as little leeway as possible in a wind, it is obvious that the old types of boat will survive. The flat-bottomed boat is

year, as certain boat-owners of Dunkirk asked for a new type of boat, characterised by a light draught, with sufficient leeboard surface to enable it to keep close to the wind, the Ecolin shipyards adopted the lines of the "sharpie," with a projecting drop-keel of a new patented type. On the other hand, M. Marcel Grenié enounces certain general principles relating to the construction of new motor-boats which he has put into practice in the motor "dandies" or ketches of Pornic and Cap-Breton : "The boat—and I am speaking more especially of the sardine boat—must be decked . . . it must have a fore-castle, enabling the crew to sleep on board when away from port . . . a well for the nets is a necessity, or the gear will rapidly deteriorate . . . finally, a hold for the fish, with an ice-box or refrigerating machinery."

IV

The programme already formulated must be carried out on the lines suggested above. Now, the question arises : How many fishing boats are there in France which could be adapted as motor-boats ? M. Sumet, general secretary to the last Congress of Automobile Navigation, says 6,300. The installation of motor-power at the rate of 7 to 8 h.p. per boat, and £22 per h.p.,¹ would cost £1,000,000. But this estimate, I fear, is somewhat too large ; I think 1,100 would be a more reasonable number, being as it is the actual number of automobile fishing boats in Denmark, Norway, and Germany. The expense of adaptation would then be reduced to £160,000. The numbers matter little, however ; what is important

only for light draught, and will probably not survive the selection of time, as the pure hydroplane with detached metal planes will eventually beat it even for racing.—[TRANS.]

¹ These rates would be lower in England.—[TRANS.]

is that France—to quote M. Sumet—“should follow the example of Denmark and Norway. This is possible, since it has already come to pass at one point on the French coast (Arcachon). But in my opinion we ought, to convince the fishermen, to multiply models of the *Goéland*, the first training-boat constructed according to the data of our colleague, J. Pérard. It would, I am certain, be of the greatest advantage to all if centres of instruction and demonstration could be established.”

Last year a discussion arose between two members of the League as to the best type of marine motor. Alcohol or petrol?—such might have been the title of the debate. M. G. Soé, the well-known naval architect, is in favour of petrol; and my friend M. Camille Mader speaks eloquently in favour of alcohol. I have followed their dispute with the greatest interest, and hitherto I do not think either has come off triumphant. Each is right for the region of which he speaks and which he represents, namely, the north and north-western coast of France and the eastern shores of the North Sea on the one hand, and the Arcachon basin on the other. But if I follow the fashion and apply the rules of proportional representation, I must admit that M. Soé has a stronger argument than M. Mader. I had the good fortune to witness the magnificent expansion of the motor-fishing industry in Scandinavia as well as in Arcachon.

As a matter of fact, the choice of this or that motor is a matter not of principle but of experience. The experience of France is too recent and too incomplete to be conclusive. We must take time—but let us employ it to advantage.

Three parties are concerned: the builder of motors, the builder of boats, and the fisherman. The first must be guided by the requirements of the other two. At

present he is not so guided. The motors for boats which the French manufacturers are turning out are almost exclusively adapted for the use of spirit, while the Danes and the Germans are making petrol motors. As the latter are protected by a law refusing the usual bounty to the builder of a French boat fitted with a foreign motor, spirit is actually protected in France. The two systems will only come into real conflict when this law is abrogated. Abrogated it must be, because the fisherman must be free to buy his experience and the manufacturer to alter his wares if occasion arise. Moreover, it should be abrogated at once, for the Germans will soon be placing petrol motors on the French market at prices so low as to countervail the loss of the bounty. When experience has delivered judgment, and when the French factories have turned out petrol motors in abundance, then, but only then, protective measures may be advisable.

Too much protection kills more than cats. M. Lumet, in a recent article in the *Ligue Maritime*, has very courteously criticised the ideas which I have just expressed. He reproaches me with recommending strong measures : "Let us use," he says, "what we French possess : that is, excellent spirit motors. . . . My object has always been to defend, by persuasion, the interests of two French industries : the motor industry and our fisheries." Then he demonstrates that "we no longer depend on the foreigner for the petrol motor." But he also adds : "I shall always see with pleasure the application of foreign motors to our fishing boats, for I am sure it will contribute to the transformation of our fishing fleet in a direction favourable to its interests and also to the extension of the market for French-made marine motors." Well, upon that point we are fundamentally in agree-

ment. M. Lumet recognises that the introduction of foreign motors will be "favourable to the interests" of our fishermen ! I ask nothing more. But if that is so, why shut the door upon these motors ? If we lock our door upon the entry of foreign products, will the foreigner open his to our products ?

V

Between spirit and petrol the future will decide. I have prolonged this discussion a little in order to show that "mechanical fishery" has not only established itself, but that it presents important problems ; while it has solved other problems which are big with consequence.

In the first place, a larger amount of fresh fish is thrown on the market. When the fishermen had only their sailing boats to rely upon, it was impossible for them to bring back fresh fish from the North Sea, for example. They were obliged to salt herring on board, in the barrel or in bulk. Now that the steamers put into port weekly (even the Iceland trawlers are rarely absent from Boulogne for a longer period than six weeks) the fish is often landed in the fresh state. Thus at Boulogne the salt fish landed in 1862 was 8,008 tons, as against 15,266 in 1906, while the fresh fish landed increased from 4,541 tons in 1862 to 45,670 in 1906 ; an increase of 90 per cent. in the first case and 900 per cent. in the second.

Salt has given place to ice. But the steamers were not the first to employ the new methods. When the little Arcachon trawlers began to work in the Bay of Biscay, one of them would take its turn to leave the fleet every morning, loaded with the catch of the various boats, and to run into port ; in other words, it acted as a "runner." At the same period the sailing vessels, which remained eight or ten days at sea, were using ice. At Lorient the

price of artificial ice was only 25s. 7d. per ton in 1907. When the trawlers are more numerous it will probably fall to 1s. per cwt. ; and this would mean a very appreciable saving, for the annual consumption of these steamers is from 400 to 500 tons. The use of crushed or pounded ice, however, presents certain disadvantages ; the water from the melting ice soon becomes a perfect broth of cultures. Artificial snow is better ; but a refrigerating plant is best of all. It is to be hoped that many trawlers will be provided with such apparatus.

France is responsible for the first attempt at the preservation of flesh on board ship by means of cold. About 1876 two companies, one at Havre and one at Marseilles, imported frozen mutton from the Argentine ; but the shareholders became discouraged and the companies were wound up. The English successfully promoted a similar enterprise in New Zealand. Some time later the "Marée des Deux Mondes" was founded at Marseilles. This company had a double object : to enter Hudson Bay each spring, obtain a cargo of salmon, and bring it back to France in freezing chambers ; and, having landed its cargo, to trawl the banks of Arguin Island by the entrance of the Baie du Lévrier on the African coast. This company also failed. In 1886 a new company, the "Trident," installed a refrigerating station at Dakar ; but the fish were of inferior quality and the refrigerating steamer was wrecked, so the enterprise was abandoned. We never hear anything now of the importation of frozen fish, although the English, the Germans, and the Swiss have been industriously developing the trade. It is true that a few French trawlers—the *Nord-caper*, the *Rorqual*, and the *Canada* among others—are fitted with refrigerators. There are also refrigerating chambers on land, as at Arcachon, and refrigerating cars

on the railways ; there are also refrigerating establishments at Bizerte, Mahdia, and Biban ; there is also the Maison Habert at Versailles—to mention only one such establishment ; and the *Bourse de Commerce* of Paris has cooling chambers. But the industry is in a very precarious condition as compared with what we see in other countries. In France the accumulation of stock, and therefore the equalisation of prices, is almost impossible. If fishing is slack the sales are contemptible. But never think that frozen fish is “fit for nothing,” as people too often repeat. Its comestible value is precisely what it was at the moment when it was frozen. If fresh then, it will be perfectly fresh five or six months later.

Now let us proceed to certain data of an economic order, which may obviously be imputed to the introduction of power. In the large ports, such as Boulogne and Arcachon, *the number of inscripts has increased*. In 1891 there were 3,105 in Boulogne ; in 1900, 3,378 ; in 1906, 4,751. They are never out of work. Boat-building yards and repairing yards have been built. Rope and line and net factories have rapidly multiplied. Various factories have sprung up which make large quantities of fish manure from refuse. The introduction of steam-trawling has resulted in the creation of limited and other companies. According to the Annual of the “Comité central des Armateurs de France,” there were more than twenty at the end of 1907—a very small number, since the port of Hull alone contains thirty-two. The working capital is usually small, as is the number of vessels owned by each company, and their tonnage. Steam fishery companies are still almost a rarity in France, and are also a matter of yesterday.¹ Private owners, or owners

¹ Year by year the budget of the German Empire provides for certain sums employed to subsidise the German fisheries, which have

in ordinary partnership, outnumber the companies in the proportion of five to one.

VI

The splendid beginnings of steam-trawling lasted only for a day. Pomona was powerless to keep the promises of Flora; for more than one fruit was nipped by a late-coming frost. I have spoken of a crisis in the trawling world. Some eighteen months ago the orders for steam trawlers and the purchases fell off; and the demand having lessened, the prices fell. I will briefly review the causes of this crisis, dividing them into two classes—internal and external causes.

As for the internal causes, it is enough to recall the difficulties of all sorts which the steam-trawling industry had to encounter at the very outset. Once the first victory was won, the owners had to wait while their men served a new apprenticeship, and of course had to raise their wages. Moreover, the first attempts were ex-

a hard struggle with foreign competition, especially in the matter of the herring fishery. These subsidies have hitherto usually taken the form of grants for the purchase of motors or the replacement of lost or damaged nets. Recently the Imperial Government has decided to grant subsidies to encourage the installation of wireless telegraphy on board the larger fishing-boats. Experiments have proved that wireless telegraphy is capable of rendering the greatest services to fishermen, as the German Observatory can not only warn them of approaching storms, but can also furnish them with useful information as to the state of the market and the opportunities which it may offer, which enables the fishermen to take their catches to the ports in which the prices are highest at the moment.

In consideration of this double advantage—safety for the crews and a remunerative market for their wares—the Government has determined that any fishing boat which installs an apparatus for transmitting and receiving wireless messages, which apparatus is estimated to cost £300, will receive a bounty amounting to half that sum. (Note by M. Benfré, French Consul in Germany.)

tremely timid, as is always the way in France. The working capital was often uncertain, and the employees too numerous. Too much material, too many expenses, low profits: these three conditions point to three fundamental errors which are easy of correction.

The other causes are more complex, for they reside in the economic life of the nation. Coal is dearer in France than in England; but that is in no way the fault of the French. All that we can do is to combine as purchasers, so as to obtain a lower price. Any one who has cast his eyes on the balance-sheets of a trawler company will tell you that the French trawler loses profits which accrue to the English trawler even before it leaves the port; these profits, of course, being the difference in the price of coal in France and in England. More: the costliness of certain indispensable materials is complicated by difficulties relating to the sale of fish. There are too many intermediaries; the municipal *octroi* taxes are prohibitive, and transport is badly organised. These are serious hindrances, which I shall deal with further in these last chapters of this book.

We must not forget, however, that the limited company is, according to Bastiat's phrase, a tissue of solidarities. The malady from which the maritime fisheries of France are suffering may certainly be imputed to special causes; but if we look into the matter closely we shall find it is a part of the social malady. The reader is by now roughly acquainted with the broad outlines of the fisheries of Europe, both French and otherwise, and is in a position to compare those of France with the others. Here and there we find different methods and different results; but where fisheries are declining, as in Belgium, we find behind them the old French organisation. France lags behind England,

Germany, Holland, and Scandinavia ; she has not adapted herself to modern requirements. She possesses a certain amount of modern material, but it is imprisoned in an ancient organisation. The harbour works at Havre have scarcely been completed, but their insufficiency is already recognised ; it will be necessary to resume them, and to excavate a large graving-dock for the new liner *La France*, which has recently been launched. It may be necessary to make room for liners as large as the *Mauritania*, as the eminent president of the General Transatlantic Company, M. Jules Charles-Roux, has stated.

The internal transport of France is far from satisfactory. Large heavy waggons are drawn by powerful locomotives over worn-out rails which were never intended for such. The inertia of the administration is echoed by the inertia of capital. Timid and vacillating when it is a question of supporting a national industry, the French will rush to the banker's counter to subscribe to a foreign loan !

These are the prime, the fundamental causes of the industrial decadence of France. The evil is not incurable, but its severity calls for drastic treatment.

CHAPTER VIII

THE MARKET

- I. Various modes of sale : sale on board, sale by sample, sale by auction—The fish markets of Boulogne and La Rochelle.
- II. The taxes upon sales imposed by the municipalities—The *octroi* dues of the city of Havre.
- III. Critical examination of municipal taxes ; their prohibitive nature ; monopolisation of the sale of fish by the cities—The *octroi* dues of inland cities.
- IV. The increased retail prices of fish—Middlemen—Effectual remedies : producers' co-operative societies and companies.

THE market value of fish is determined by a number of considerations. The two prime factors are—the abundance of fish and man's habit of consuming it. But fishing is a fatiguing labour, and even though, as Franklin affirms, he who fishes picks a piece of money out of the sea, he has at least the trouble of finding it and carrying it home. The value is thus determined partly by the labour involved, and finally by the cost of butcher's meat. At Geestmünde, for instance, the ton of fish, which usually sells for £12 or £14, rose to £20 in 1905 on account of the dearth of beef and mutton.

I

The cutters of Douarnenez have not time to enter the harbour before their catches of sardines are bought by the buyers posted on the breakwater.† The manufacturers are kept apprised of the fluctuations of the market price over the telephone. At Gujan-Mestras the sardines are delivered on the quay sometimes direct to the manu-

facturers, sometimes to the market. Many fishermen sign contracts with the manufacturers. Sardines are always sold by the thousand. In mid-winter the thousand has often risen to £2 and £2 16s., but the price always falls in spring and summer: to £1 12s. in May, and 9s. 6d. or even 6s. in June. Tunny are sold by the dozen.

In certain cases the sale is by sample, and the fish is delivered on board. This is the case with herring and mackerel, fresh or salted. Fresh herring or herring salted in bulk are sold by the *land* last of 100 measures. The measure is equivalent to 20 litres or 35·2 pints, and the last weighs from 2,100 to 2,200 kilogrammes—2 tons 1 cwt. 1 quarter to 2 tons 3 cwt. 1 quarter (approximately). Salted herring sold by weight are sold by the *sea* last of 13 tons for 12, which is equivalent to 60 measures; a last should weigh 1,212 kilos = 1 ton 4 cwt. (approximate). Herring salted in the cask are sold by the last of 12 tons, each weighing 101 kilos net, or 223 lbs., the weight of the last being the same as in the preceding case. At Boulogne, Portel, and Fécamp the average price of salted herring is £8 to £9 12s. It is, of course, higher in summer than in autumn, as in autumn it has to compete with the fresh herring. The box of herring sells for anything from 4s. 9d. to 12s. Mackerel are sold by the hundred, which means 110 tails with a handful or two extra; cod by the ton and the quintal. The chief market for cod is at Bordeaux.

All other fish are taken to the floor of the market directly the boat is moored to the quay. At Aberdeen they are sold in lots of 5 to 10 pieces. Cod, ling, and flounders are sorted into rows and sold by the group. Small fish are set aside in lots of 1 cwt. and sold by the box. At Geestmünde the buyers foregather every morning, and sales by auction commence under the

supervision of the official auctioneer, the fish being sold in the order of arrival as posted on the notice-board. With the exception of herring, which are sold by the box, all fish arrive in the market ready weighed. At Cuxhaven fish are sold by auction in quantities not less than 50 kilos (1 cwt., approximate). Herring are sold either by weight or by the basket, cask, or tun.

In France all sales by auction take place under the supervision and according to the bye-laws of the municipalities. The fish market at Boulogne comprises a wholesale market for the sale of fresh fish, excepting herring; a market hall for wholesale dealings in herring, fresh or salt; and a retail market for all kinds of fish. The market of La Rochelle is in two parts: there is the Carmes market for the sale of the best-known species, and the Chaîne market for the sale of inferior species and shell-fish. The Carmes market is divided into the Grand Encan and the Petit Encan—the large and small auctions. In the Grand Encan the fishermen can have the use of 16 slabs or tables at the rate of one slab for 16 fish. The soles, according to their size, are sold in lots of 20, 12, or 9 pairs, hake in lots of 8 fish, rays in lots of 8 to 20 fish, tunny in lots of 6 to 12 fish. The auctioneers settle the price to be set upon the fish exposed with the sellers; but in case of disagreement they must give way to the sellers. Immediately after the auction the seller gives the list of his sales to the collector of the market, who immediately pays him the whole amount. Article 8 of the regulations stipulates that "all fish and all crustaceans or shell-fish introduced into the market or its dependencies may be removed only after having been sold by auction at the hands of the agents of the administration. This rule admits of no exception. Fish once displayed cannot upon any pretext be withdrawn or replaced before the sale."

II

The solicitude of the administration of the market is never disinterested ; there is always a bill to pay. It must be admitted that in some of the French fishing ports the dues are very moderate. At Boulogne they never exceed $1\frac{1}{2}$ per cent. on the sales. At La Rochelle the sellers have to pay three-halfpence for each place or table, and the buyers an auction due of 3 per cent. on the sale price. From the "Report of the Administration for the year 1907, Commune of La Rochelle," I quote the following figures:—

REVENUES OF THE FISH MARKET.

<i>Auction Dues</i> (3 per cent. of the amount of sales) :						£	s.	d.
Grand Encan	...	...	...	...	...	4,799	19	8
Petit Encan	...	...	...	...	...	799	8	$9\frac{1}{2}$
<i>Place Dues</i> ($1\frac{1}{2}$ d. per place) :								
Grand Encan	...	...	...	...	...	3,357	16	$2\frac{1}{2}$
Petit Encan	...	...	...	...	...	1,277	13	5
<i>Storage Dues, Packing Hall :</i>								
Grand Encan	...	...	...	...	...		9	12 0
Total						£10,244	10	1

In 1906 the total was £558 less. In 1907 the total of the sales was £186,612, as compared with £184,256 in 1906. Of the £10,244 received by the city only £1,200 was spent upon the needs of the market.

These dues differ in different cities. Last year was published a careful examination, full of details and references, of the municipal bye-laws of the city of Havre. By the terms of the municipal resolution of November 21, 1899, relating to sale by auction, and that of December 30, 1905, relating to *octroi* duties, fish must be taken to the market at least half an hour before the opening of the first sale, and *each seller may make use of two tables only*, or a total area of two square mètres, on which to

display his wares, whether they consist of four or five tons of fish or ten or a dozen mackerel. This regulation may have been reasonable in the days when all the fishermen used small sailing boats, but since the triumph of the steam trawler it is literally grotesque. The injury done to the large producer can be imagined ; for, offered at the end of the market, his wares will have suffered a depreciation amounting on some days to £20 or £25.

You may suggest : " But nothing is easier than to sell the fish outside the market." On the contrary : it is impossible. All fish sold to the consumer direct or through an intermediary (other than the auctioneer) is taxed at the rate of *twopence-halfpenny* per kilogramme, or more than a penny per pound. On January 22, 1909, at 11.30 in the morning, a private person bought a lot of herring at the market price for the sum of sevenpence-halfpenny. He had to pay *a tax of three shillings and three-pence-halfpenny* ; that is, he paid the city five times the price of the fish. So the fisherman is forced to carry his fish to the market hall. If it is not sold at the end of the day it will be stored overnight and taken out next day at the opening of the market. But the auction is not gratuitous : by no means. There is a due of 5 per cent. on the value of the merchandise, and a supplementary tax of 3 per cent. for auction rights, or in all 8 per cent.

III

Taxation of this sort is open to various criticisms. In the first place, these taxes make life dearer for the poorer classes ; then they constitute a progressive impost upon food, which amounts to £1,600 to £2,000 a year. Moreover, the legality of the 3 per cent. tax is doubtful. " The fish market is a municipal service, and the collectors of the *octroi* and the auctioneer are municipal servants, who

should be paid out of the city budget. Why should the cost of their remuneration be charged to the sellers of fish? There is also a supplementary tax in disguise, all the more irregular in that by the terms of the law of December 24, 1896, the right to sell products caught or gathered by naval inscripts does not carry with it liability to personal taxation or payment of any kind whatever." The crews employed by the shipowners are, as a matter of fact, condemned to pay an annual tax amounting to not less than £480 or £600 a year for each steam trawler, which represents an annual tax of some £5 per man. As for the specific tax of 2½d. per kilo, it is absolutely prohibitive if imposed on fish of inferior quality, such as gurnards, herring, and dogfish, the price of which often falls as low as a halfpenny a pound. The *octroi* at this price amounts to 400 per cent. of the value of the goods. Now the general decree of 1870 enacts that "salt cod, stock-fish and salt herring cannot be taxed. This, with the double object of stimulating French fisheries and of leaving untaxed all kinds of food consumed especially by the lower classes." These exaggerated tariffs are therefore contrary to the spirit of the law.

There is another objection upon which M. Dero, shipowner of Havre, has particularly insisted: "The enormous figure of the tax imposed upon direct sale virtually forces the producer, especially when his stock is large, to get rid of his fish from the tables of the city auction. It is only too evident that in offering one the choice of paying a duty of 8 per cent. on fish sold by auction or a duty of 125 per cent. to 400 per cent. on fish sold by personal contact, the city is establishing *an absolute monopoly* to the profit of the public market. To prevent the shipowner or the merchant from plying his trade under the conditions most convenient to him, and to force him

to take his wares under the roof of the market, is to exercise an indirect but irresistible constraint upon him." The Council of State and the Appeal Court have repeatedly pronounced null and void such *octroi* tariffs as tend, in any shape or by any means, to produce such a result.

Example : On August 6, 1892, the Mayor of the Commune of Grandcamp issued a decree forbidding the wholesale sale of fish on the public highway. All fish sold in the commune, even if intended for exportation beyond the boundaries of the commune, were first to be taken to the market, to be verified and taxed ; and if the fishermen wished the verification to be effected on board, they had to pay a far heavier tax. The Council of State, considering that the Mayor of Grandcamp had acted solely in the financial interests of the commune and of the patentees of the market, annulled his decree. Lorient also was judged "to have created a monopoly to the profit of the patentees," and Cancale to have "conditioned the sale of fish in such a manner as to force all the fishermen to resort to the officials of the market."

In short, the law is strictly against the monopolisation of the sales of fish by the cities. Not only the Council of State and the Court of Cassation, but ordinary common sense protests against the taxation of the same product on two different scales, according as it enters a town by this or that entry. This objection holds good, alas ! not only for Havre, but for nearly all the towns of France. Let us proceed a little further.

With the exception of Havre, Trouville, and Cherbourg the more important fishing ports impose no *octroi* duty upon fish. But in the inland cities the duties fall thick as hail. Their object is to protect butcher's meat, while along the coast they serve in the first place to protect the interests of the small fishermen who depend

upon their sails for motive power, who have elsewhere been defeated by the steam trawlers. The duties are never less than 5 fr. per quintal—nearly 4s. per cwt.—and often amount to 10 fr.=8s.; at Cahors, for example, Chateauroux, Angoulême, Reims, Roanne, Dijon, &c.¹ The *ad valorem* duties vary between 5 per cent. and 55 per cent. I have before me the official figures relating to the city of Rennes; they show duties of 33 per cent., 44 per cent., and 55 per cent. Here are two very curious documents :—

Goods forwarded from Monsieur A—, Havre, to Monsieur B—, Limoges.

Invoice of Goods.				To Pay (Expenses).			
		Fr.	Cents.			Fr.	Cents.
10 Cases of Herring ...	30	0		Storage and Unloading	0	10	
10 " " ...	25	0		Carriage ...	35	55	
10 " " ...	10	0		Duty (<i>Octroi</i>) ...	16	60	
				Postage of Letter ...	0	10	
Gross Total ...	65	0		Commission ...	3	25	
						55	60
				Balance ...	9	40	

Goods forwarded from Monsieur C—, Havre, to Monsieur D—, Verdun.

Invoice of Goods.				To Pay (Expenses).			
		Fr.	Cents.			Fr.	Cents.
20 Cases of Herring ...	20	0		Carriage ...	29	0	
				Cartage ...	0	50	
Gross Total ...	20	0		Duty (<i>Octroi</i>) ...	11	10	
				Correspondence ...	0	15	
						40	75
				Balance ...	20	75	

¹ The municipality of Paris has divided fish into three classes : first class, salmon, red mullet, crayfish, lobsters, bars, brill, turbot, and shrimps, 40 fr. 20 per 100 kilogrammes (about 16s. per cwt.); second class, soles, grey mullet, eels, sturgeon, 21 fr. 60 per 100 kilos (about 8s. per cwt.); third class, mackerel, herrings, unny, flat-fish, &c., no duty.

Remember this : part of the commissions and tips paid to the market porters returns to the coffers of the city, since these municipal servants buy their posts or pay in their makings. These are also, in a certain sense, taxes in disguise. In a word, the municipalities absorb at least a FOURTH PART of the earnings of the shipowners and fishermen. It would be better at once if the municipalities were to post up a placard of this sort about the streets : " The eating of fish is forbidden. Any infraction of this regulation will be punished by means of a fine," and a gendarme should be stationed by each placard.

IV

Fish has an evil time of it in France. Scarcely has it escaped the steely claws of the tax-collectors when it falls into those of the middlemen.

There are at least two middlemen between the producer and the consumer : the fish-salesman and the retail shopkeeper, who, by extracting obviously legitimate profits from their transactions, increase the price paid by the consumer. For example, supposing that whiting is being sold in the Paris markets at 7d. the kilo (about 3d. the pound), the retail merchant will charge as much as 1s. 7d., or an augmentation of 183 per cent. And the consumer does not profit even when the market prices are low in the ports. As the author of certain anonymous articles which appeared in the *Nouvelliste* of Lorient remarked, " Experience proves that the fall in retail prices is very far from being in proportion to the fall in wholesale prices. As the retail merchants find it to their interest to make a given profit, no matter how small the sales, there is a sort of tacit understanding among them which sets a limit to any reduction of prices. We see the same thing in the case of wine ; in spite of

the low prices from which the producers have suffered, the retail prices have not perceptibly decreased. Consequently, increasing consumption does not tend to moderate them either," so that many a housekeeper prefers to buy butcher's meat.

At the municipal auction the fishermen are forced to accept the prices offered,¹ whether remunerative or not, must submit to the fluctuations of a forced and often deficient sale, and look on as powerless spectators of the manoeuvres of speculators, who, profiting by the situation, very often act more like pirates than respectable tradesmen. In short, it is not the fisherman who makes the market.

It is the same when the sale takes place on board the boat itself. At the Congress of Maritime Fishers of Dieppe, in 1898, M. Roussin, Commissary-General of the Marine, wrote in his report: "Warned by telegraphic advice of the needs of each place, of the probable sale price of each class of fish, the salesman goes to the quays, and, on the arrival of the boats, concludes in a few words the purchase of each catch *en bloc*, and pays the price. More often than not he has made advances to the crew in the shape of provisions, or perhaps even gear, and pays himself back by instalments; more often than not the bargain is

¹ Our English fishermen, especially in small ports, suffer greatly from the lowness of prices fixed by "rings" of buyers. Moreover, the small local buyer is excluded from the market, and has to obtain his fish from distant ports. There are many English ports where plenty of fish is caught, yet none fit to eat can be obtained in the town, as it is all destined for the distant market; and after a double journey and a day or two of exposure on a dusty slab it is practically unfit for food. Occasionally an isolated fisherman will take his catch round in a basket or truck. I have known such men to amass small fortunes; but such initiative is rare. Routine is all-powerful.—[TRANS.]

struck in a drink-shop, and it is sealed by an often excessive amount of wine or spirits, which the fisherman has to drink on the spot. The consequences of this system are easy to foretell. Forced by his precarious finances to take a cash price for his fish, obliged to accept the conditions of the merchant, who has advanced him goods or money, and unable therefore to benefit by any competition among the buyers, the fisherman is at the mercy of the latter. One does not require much knowledge of human nature to guess at the manner in which such a man is exploited. The sometimes incredible differences in the prices of certain fish in port and on the markets corroborates these statements."

In some towns the master-fishermen (*patrons-pêcheurs*) have founded societies (*syndicats de vente*) in order to defend themselves against the middlemen; but not being provided with sufficient capital, they were unable to maintain them. At the end of 1897 they created a co-operative society of sale and consumption: "*Les Pêcheurs français*." This society soon disappeared. The *Musée social* then resolved to take the initiative and to found yet another society: "*La Pêche co-opérative*." Here are the principal rules of this society as given by M. Roussin: "The capital will be variable in this sense, that the fishermen, entering at the outset in uncertain numbers, but afterwards forming in groups about the first adherents, must be interested in the society to the extent of holding each a share of £1 value, which will bear an interest which we have limited to 4 per cent., payable out of the reserve capital, and ranking first. As for the rest of this reserve, it will be divided at the end of the business year among the shareholders in proportion to their productiveness:

that is, in proportion to the respective amounts of fish brought in by the co-operators properly so called. In this way, the mere subscribers of capital being set aside, this balance, which will really be simply a surplus, consisting of the dues paid by stoppages out of the product of the work of the associated fishermen, will return to them, as it should. . . . The enterprise having no resources but the net product of the sales, it will be necessary to maintain some margin between this sum and the sums paid to the fishermen. How is this margin to be obtained, and what should be its dimensions? The society solves the question by fixing the price of the fish, after its delivery by the associated fishermen, at a mean rate which has to be determined after consulting the local trade; this rate is of course variable, but is fixed before the sale. We fear that, with an article subject to such great variations of price, this procedure has its dangers, and that this has been one of the causes of the lack of success of the society which has adopted it. Our intention is to pay the associates the result of the sales only after the money has been realised, then deducting from the net price (the special expenses of each shipment being deducted) the amount considered necessary. In this way the institution retains its character as a co-operative society; it does for the fishermen what they would do for themselves if they banded together to dispose of their catches."

In reality, almost everything is yet to be done in the matter of co-operative production and sale. The poverty of the fishermen, their slow, distrustful minds, and their intestine dissensions are all so many obstacles in the path. Some shipowners, however, have very successfully formed such societies. In La Rochelle a co-operative union was formed about a year ago among the

owners of steam trawlers in that port, its object being to keep the sale price of fish in the market as high as possible.

If I may use a vulgar but expressive symbol, I would represent the French fisherman as struggling with two men who are trying to strangle him, while a third strews impediments on his path. The two first are easy to recognise—the *octroi* and the middleman. And the third is the railway.

CHAPTER IX

THE OUTLETS

- I. A glance at the railway transport of France. II. Railway tariffs in France and abroad ; the poor organisation of the French railways ; the principal grievances of the fishermen and forwarders. III. The consumption of fish in France ; imports and exports ; foreign competition in the sardine trade. IV. A few words concerning the market of Basle—Refrigerating cars—Billingsgate. V. The commercial vicissitudes of fish—Fresh fish : importations in Germany, Switzerland, Belgium, Austria—Preserved fish : importations of herring in Germany, Russia, and the United States ; of cod in Spain, Portugal, Italy, and Brazil.

THE coast train is the necessary adjunct of the steam trawler. The coast may bristle with fishing boats in vain if the fish are not immediately distributed among the inland markets. It is essential that merchandise should circulate with ease and punctuality throughout the whole country. This evident truth has been put into practice by the English and the Germans, without waiting for reports and inquiries to accumulate dust and age upon the desks of Government departments.

I

Far be it from me to attempt a complete study of the difficult question of railway transport. I will confine myself to placing before the reader a few characteristic examples which will prove the shocking inferiority of the French railways to those of other countries.¹

¹ The details given are cited from the report of M. Amédée Berthoule to the Consultative Committee of Maritime Fisheries

To begin with, fish can be despatched in three ways : by *grande vitesse*—or express goods ; by *grande vitesse conditionnelle*—or conditional express ; or by the system of *denrées accélérées*—literally, accelerated goods. In the first case the weight of the package must not exceed 30 kilos, or 66 lbs. ; in the second, there is no limit of weight, but the trains by which this service is effected are few in number, whence annoying delays. (The familiar tariffs apply to the second system ; special tariffs, G.V. 14 ; general common tariff, G.V. 114.) There are special tariffs relating to the Western State Railway, the State Railway, P.L.M. Railway, and the Northern Railway (*Ouest-État ; État ; P.L.M. ; Nord*). The general tariff, G.V. 114, is common to all the railways excepting the Midi. It makes a uniform charge for loading and unloading of 1 fr. 50 (1s. 2½d.) per ton.

The cost of freight per kilometric ton is given by a ready-reckoner.

For the first 300 kilometres (186 miles) the tariff is 69 fr. (£2 15s. 2½d. per ton, or 23 centimes per kilometre per ton, which works out at 37d. per mile. For greater distances the tariff is as follows :—

Kilometres.	Miles.	Fr.	£ s. d.	Per Ton.	
				Per Kilometer.	Per Mile.
				Fr.	Pence.
400 =	248	83 =	3 6 5	·207 =	3'3
500 =	310·5	93 =	3 15 5	·186 =	2'9
600 =	372·6	103 =	4 2 5	·171 =	2'75
700 =	434·7	113 =	4 10 2	·160 =	2'56
800 =	496·8	121 =	4 16 5	·151 =	2'4
900 =	559	111 =	5 8 0	·135 =	2'16

(*Journal officiel*, June 11, 1905); from the speech delivered by the deputy M. Le Bail in the Chamber (*ibid.*, February 16, 1905); from the report of M. Tanazacq to the Congress of Maritime Fisheries of Les Sables-d'Olonne, 1909. Most of this paragraph appeared in my memorial to the *Ligue maritime*, as already cited.

The application of this scale gives us the following results : The cost of transporting a ton of fish from Boulogne to Paris is 42 fr. 90= $\pounds$ 1 14s. 3d. ; from La Rochelle to Basle (878 kilometres=545 miles), $\pounds$ 6 1s. 5d. ; and from Lorient to Paris, $\pounds$ 3 4s. 9d. From Havre to—

	$\pounds$	s.	d.			
Nancy ...	4	0	9½	per ton or	1s. 3'47d.	per box.
Lyon ...	4	13	1	„	1s. 2'4d.	„
Saint-Etienne	4	13	3	„	1s. 2'4d.	„
Bordeaux ...	4	14	10	„	1s. 2'88d.	„
Toulouse ...	5	5	0	„	1s. 4'32d.	„

The Midi Railway not having adopted the general common tariff, a ton of produce sent from Arcachon to Avignon, or a distance of 393 miles, costs $\pounds$ 5 10s. 5d., while the freight on the same amount sent from La Rochelle to Avignon, over a distance of 497 miles, costs only $\pounds$ 3 16s.

II

A Frenchman feels almost ashamed to compare the freight tables of his own country with those of foreign railways. Let the reader consider the following table. Columns of figures are tedious, I know, and they often have no other object than to give a book a learned, authoritative, and therefore respectable air. As people are not fond of the respectable, such books are seldom read; a fact which justly punishes the author for an offence committed in a spirit of trivial and pedantic pride. I hope I myself may be pardoned, for I have not sinned very deeply; whenever I have cited figures in the course of this book it has been because I thought them indispensable. So here, cited from Commandant Charlier, is a table of

comparison between the freights of German railways and French.¹

From Boulogne to	Distance in Kilo- metres.	French Tariff G.V. 114 per Ton metric (2205·5 lbs.) (in Fr.)	German Tariff.			
			1 Ton.	5 Tons (per Ton).	10 Tons (per Ton).	Herring, 5 Tons (per Ton).
Bourges	498	92·8	58	44·25	38·87	32·62
Chambéry	824	122·92	82·57	71·5	63·25	53·
Clermons-Ferrand	683	111·30	71·87	59·75	52·75	44·25
Dijon	579	100·90	64·00	51·00	44·87	37·75
Limoges	666	109·60	70·62	58·25	51·60	43·12
Lyon	758	117·60	77·50	66·00	58·37	48·87
Montpellier	1,017	135·68	46·87	87·62	77·75	65·12
Toulouse	1,014	135·58	96·62	87·37	77·50	64·81

The special rates of the Northern Railway do somewhat approach the German rates. In England the freights on fish between Hull and London, Aberdeen and London, Aberdeen and Birmingham, are about half as much as they would be by the French tariff G.V. 114.

These high freight-rates are aggravated by special regulations. In Germany and England shipments are received ten minutes before the departure of the train ;² the French companies demand three hours' grace. Nor is this the worst. At various points on the journey there is fresh delay : three hours when the station is common to two railway systems ; six hours if each railway has a separate station ; six hours at the various termini in Paris. Then there are delays in delivery : two hours after the arrival of the train in the day-time ; or, if it arrives at night, two hours after the opening of the station. Finally, five hours' delay in portorage. In Germany and England fish is accepted by the express trains ; not so in France.

¹ For details of railway service in fishing-ports, see Part II., Chapter II.

² All the busier English fishing ports have special "fish-trains," put on at the time most convenient to the buyers.—[TRANS.]

At this point the reader will begin to understand why the English and German fisheries are prosperous, and also that the railway is as important a factor in fishery as the steam trawler. In France the efforts of the shipowners, the ability of the fishermen, the efficiency of boats and gear, are all annulled by the heavy freights, which are aggravated by the *octroi* duties. The word "annulled" is not too strong, for sometimes sale is impossible. In fact, as the tariff G.V. 114 is only applied when the goods travel by at least two railways, a number of towns in the centre of France are deprived of fish simply *because they are directly connected with the fishing ports by a single railway system.*

On the other hand, the expenses of shipment, freight, and delivery on a box of 100 herrings, sent from Havre to the Halles of Paris, raise the price of the said box from 3d. to 1s. 4³/₂d. Now it often happens that the box is sold in the said market for 1s. ! The average price of a measure of herrings in the French ports may be put at 9⁶/₁₀d. The freight from Calais to Paris, without mentioning accessory expenses, costs 9⁵/₁₀d. Here all profit disappears ; the fisherman loses. To avoid this danger, the owners of fishing boats in the north of France used to send a very large stock, certainly the greater part of their produce, to the fish-merchants of Antwerp, who reshipped it to Germany or Switzerland, the freights in both countries being low. This outlet was recently closed, and they have not been able to send the fish to the Swiss or German markets themselves on account of the excessive freights on the French railways ; they could only let their boats go out of commission. The inevitable result has followed : a violent crisis in the herring industry.

Things are quite as bad in the matter of shell-fish.

A metric quintal of shell-fish—about 121 lbs.—is worth about 11s. 2½d. in Croisic market. The cost of carriage to Paris is about 8s.; to Grenoble, Vesoul, Nancy, 10s.; to Avignon, 10s. 8d.; to Marseilles, 11s. The trade in mussels has penetrated only a very limited area of the country. In Paris it painfully wages an unequal war, and furnishes hardly a third of the total consumption, two-thirds at least coming from abroad. In 1904 Paris bought 138 tons of mussels from Holland and 6,930 from Belgium, while the French mussel-beds furnished only 2,041 tons. Thus yet another French industry is languishing under the burden of heavy freights. Considering their specific weight and their low value, shell-fish ought to be granted a rebate of at least 50 per cent. on the ordinary rates. But these rates, which press so hardly on French products, are diminished for foreign fish. The fish sent from England to Paris pays 32s. 2d. from Calais to Paris, while French fish pays 37s. 7d., or a difference of 5s. 5d. in favour of the former; an injustice all the more shocking in that the shipments from England which are thus protected consist almost exclusively of those species which are subjected to the most excessive rates in their own country.

The various Fishery Congresses have put these grievances before the railway companies. Among other requests, the Congress of Bordeaux expressed a wish that goods should be accepted an hour before the departure of trains; that the clause demanding twelve hours' notice in the case of the most rapid itinerary should be limited to the first shipment by the same person to the same place, &c. The Congress of Les Sables-d'Olonne (1909) repeated the majority of these requests. They also requested the companies to accept parcels of fish for all trains composed of these classes of carriages,

and for express trains for journeys of 300 kilometres (186 miles) as is customary in Germany.

The reforms that are indispensable are so numerous that it is wiser not to ask for too many at once. As the distinguished president of an important provision company recently remarked, if the railways would run their fish trains a little more speedily and would treat the shipments with a little more care, that in itself would be a great advance.

III

In France more than in any other country the railway freights and *octroi* duties ought to be unusually moderate. The reason is simple, and takes the form of the Frenchwoman. She is too good a cook ; she is wonderful in the preparation of all kinds of delicious dishes, in the concoction of succulent sauces, in the production of entrées based upon the baked meats or boiled of the day before ; so that the Frenchman's menu is not so narrowly restricted as the Englishman's or the German's. They, deprived of the light and delicious dishes known to the French housekeeper, eat fish almost daily, principally as a matter of habit. People are always saying that the modern young woman is no longer the good housewife that our fathers knew. Perhaps, in spite of the extremely learned lectures and classes which she attends, she will be a less instructed cook ; but what matter if the lamentations of mothers and husbands are counterbalanced by the joy of our fishermen ?

Experience proves, moreover, that the consumption of fish increases with the improvement of transport. In 1887 the freight from Boulogne to Paris was £3 14s. 9½d. Since 1900 it has been £1 14s. 3½d. Result, the shipments of fish have increased from 8,925 tons to 27,363

tons (in 1904). In other words, when the rates were rather more than halved the traffic was more than trebled, and the railway received nearly 40 per cent. more in freights.

The Parisian consumes 250 grammes of fish weekly, or .55 of a lb., or 28 lbs. in a year. In a paper presented by M. Anthony to the Bordeaux Congress, he divided the cities of France as follows into five classes, according to the annual consumption of fish per inhabitant. (1) Consumption of more than 44 lbs.: Beauvais, Nice, Marseilles, Havre; (2) less than 44 lbs. but more than 33 lbs.: Cherbourg, Nantes; (3) less than 33 lbs. but more than 22 lbs.: Paris, Poitiers, &c.; (4) less than 22 lbs. but more than 11 lbs.: Saint-Nazaire, Orleans, Tours, Avignon, Roubaix, &c.; (5) between 11 and 2.2 lbs.: Montpellier, Lille, Grenoble, Nancy, Lyons, Nevers, Versailles, Roanne. The two extremes are 74.8 lbs. and 2.2 lbs. While in England many inland villages and all small towns are provided with well-stocked fishmongers' shops, the inhabitants of many of the lesser cities of France scarcely ever taste salt-water fish, and many peasants have never seen it. A few miles from Fécamp the people do not know what a fresh herring is!

Fish does not penetrate into the body of France in any great quantities, except in the preserved form: sardines in oil, salt or dried cod, red herrings, &c. The national yield does not always suffice. Sardines are imported from Spain, Portugal, and Algeria; lobsters from Canada, Belgium, Holland, Great Britain, Spain, Portugal and Italy; salmon from Holland, Great Britain, Germany, Switzerland, and Belgium; various fresh fish from Algeria, Spain, Great Britain, Belgium, Holland, and Tunis. The Canadian salmon reaches France in a very original manner. It is frozen directly it is caught

and shipped to Southampton in English vessels fitted with refrigerating machinery. Thence it is reshipped to Hamburg, and thence it is sent by rail to Basle, where it is stored by the famous Maison Christen, which establishment sells and despatches it to the French fish-salesmen. The same firm of Christen used to receive, and doubtless still receives, a great deal of fish from Boulogne, *via* Ostend. This is tinned or otherwise preserved and sent all over the Mediterranean coast at the beginning of the season, and to the large hotels of the watering places. So we find this absurd condition of things: that the fish caught by French fishermen and landed in French ports pays customs duties before it can be consumed in France! I say nothing of the expenses of shipment, freight, warehousing, reshipment, &c.

The Halles of Paris do not sell French fish only. In 1888 they received 22,000 tons of fish; in 1905 nearly twice as much, namely, 40,000 tons, of which 2,273 came from abroad. In 1903 the imports amounted to 2,139 tons; in 1904 to 2,503, of which 651 were from England, 815 from Belgium, and 1,035 from Holland. As the supply of fish does not exceed the demand, the price per lb. is in the last resort decided by the comparison of the nutritive and other qualities of fish with those of meat and other foods; but if the supply increases we shall first see the consumption remain for some time stationary, and the effect of competition will be to lower the price of fish until it falls to the neighbourhood of its cost in the market of origin. The fall might be considerable, and a certain quantity of fish, that coming from ports where the cost price is highest, might remain unsold.¹ A kind of natural selection would come into

¹ " *L'avenir du port du commerce de Lorient* " (Lorient, 1907).

operation as affecting the various ports, preserving and enlarging the best and eliminating the worst.

The French imports of fish amount to £2,000,000; the exports to £1,200,000 only. The national consumption does not amount to more than £5,600,000.

France sells sardines in oil to the United States, Germany, Great Britain, Russia, Denmark, Belgium, Holland, Switzerland, Egypt, Algeria, and the Argentine; salt or dried cod to Italy, Spain, Greece, Algeria, Martinique, Guadeloupe, Réunion, and French Guiana; various preserved fish to the United States, Great Britain, Belgium, Switzerland, and Algeria; fresh fish to Spain, Switzerland, Belgium, Great Britain, Italy, and Germany.

Sardines in oil are a typically French export. Unhappily, the recent crises on the coast have done the trade considerable damage. While a case of 100 boxes, with 10 fish in each, costs £1 8s. 7d. in abundant years and £2 4s. to £2 8s. in lean years, a like case of Spanish sardines is priced at £1 to £1 2s. 5d. in Bordeaux market. To Spanish we must now add Algerian and Japanese competition. In Algeria the net price is higher than in Spain. A case of Japanese sardines in oil costs £1 4s. 11d. free on board at Kobé. Counterfeit goods have come to the aid of competition; but the law of July 11, 1906, relating to the protection of the sardine trade against foreign counterfeits is, says M. Le Bail, the author of this law, a decisive factor of safety. Spanish or Portuguese or Japanese sardines used to be imported in plain tins of large or small size, or in tins printed with fictitious labels, and after certain ingenious manipulations were re-exported as French goods. This evil repaired, M. Le Bail now threatens Algeria; he does not consider that Algerian products should be sold as French. This is going a little too far, as Algeria is

part of Greater France. If some of the manufacturers of the Breton coast would emigrate to Oran or Bône it would be a good thing; this exodus would relieve the congestion of the coast, and would doubtless, with the aid of selection, result in the adoption of new methods of seine fishery and of mechanical canning among the Armorican fishermen and workmen. I would rather see some of our manufacturers go to Algeria than to Portugal or Spain.

But I entirely agree with M. Le Bail as to the desirability of obtaining for us from the public authorities the advantages of the "drawback"—that is, the repayment after re-exportation of the duties paid upon the importation of such wares as oils and tinplate, which are used in the sardine manufacture. The "drawback" exists in Spain, Portugal, and Italy; why not in France?

IV

I am going to compare two foreign markets, famous for their enormous trade, with the French markets which I have been describing: the markets of Basle and Billingsgate.

Basle is a sort of European clearing-house for fish. It receives fish from every direction; it despatches fish in every direction. We have already seen the part which it takes in the salmon trade. Its trade increases year by year. As long ago as 1892 France was sending fish to Basle to the value of £13,800; the figures for Germany were £27,040, for Belgium £16,680. Since 1904 France has carried on a considerable trade with Basle, shipping over £40,000 worth of fish annually. Belgium, Germany, and England send each about £20,000 worth of fish; Russia sends to the value of about £8,000, the United States £5,200 worth, Italy and Scandinavia each £4,000 worth.¹

The importation of fresh fish in refrigerator cars exceeds £120,000. In 1903 it rose to 15,811 quintals, or £116,000, France figuring for 3,171 quintals.

The warehouses at Basle are refrigerated, so the merchants can amass stocks of fish and render themselves relatively independent of the market. The refrigerated warehouse is the indispensable complement of the refrigerating hold of the steam trawler; the bond of union between the two is the refrigerator car. In ordinary trucks a ton of ice loses, in the middle of summer, about 6 cwt. of its weight in twelve hours; but if the walls are lined with cork the loss is only some 65 to 90 lbs. There are two forms of refrigerator car. Either the cold chamber is cooled by a packing of ice surrounding it, which is itself isolated from the exterior by a special sealed partition, or the chamber is cooled by a little refrigerating apparatus fitted to the car.¹

Billingsgate is the most important of the world's fish markets. London devours every day 1,540,000 lbs.—700 tons—of fish; more than 250,000 tons a year, or nearly three-quarters of all the fish consumed in England (not including herring). Eleven railway companies, most or all of which have an office especially occupied with the shipment of fish, pour into Billingsgate an average load of 550 tons per diem, or 198,000 tons a year. The rest comes by water. "The fish brought by water," says M. Roy, "come regularly by four carriers or runners from the Hull fleet, that port being badly placed for the use of the railway. The quantity averages about 150 tons a day. The Dutch also send the larger part of their shipments of eels directly to Billingsgate in sailing vessels. Eleven enormous glass doors give

¹ All refrigeration on a large scale is effected by the cooling of compressed gases by radiation or cold water. The expanded gases—usually rarified—then circulate through the refrigerating pipes. Ammonia vapour is usually employed, a vacuum pump causing it to "boil" rapidly, giving off an intensely cold vapour; but air can be used.—[TRANS.]

directly on to the Thames, opening upon the wharf, where muscular porters, dressed in white and wearing felt hats with enormous brims, unload the contents of the trawlers or carriers which are moored there. On the other side of the market, in Fish Street, there is all night long a slow procession, a block of vans coming from the different railway stations with their 'perishable' goods; then, during the whole morning, other vans remove the lots which have been sold. The neighbourhood of the market consists entirely of the warehouses of wholesale fish merchants, who sort the fish and give them a preliminary cleaning before sending them to the retail merchants, the large restaurants, and also to private people, directly, in small cases which are delivered in vans." Before being declared fit for sale, the fish is inspected by a commission of the "Worshipful Company of Fishmongers," which holds letters patent granted by King Edward I. at the beginning of the thirteenth century. It is this ancient society which in 1882 founded the "North Sea Fishery Protection Association," a federation of more than 50 fishing companies situated in the various ports of the United Kingdom.

I have already, in speaking of Basle, given some details concerning refrigerator cars. *A propos* of Billingsgate, I must touch upon the matter of reservoirs. I shall thus have mentioned the two ideal methods of transporting fish: frozen or chilled, or in the living state.

The simplest reservoir is that of the Norwegian herring-fishers: they tow close inshore and anchor their seines bursting with herring, which they take out as they need them.¹ The French sole and plaice fishers put the fish in

¹ In St. Ives Bay the pilchard seine is often left for a few days moored in shallow water; usually when the fishermen are waiting for fine weather for the "tucking" process.—[TRANS.]

perforated boat-shaped boxes, which they tow into port behind their vessels. But these are primitive devices; the usual reservoir is on board the vessel itself. *Bateaux-viviers*, "fishpond boats" or "live carriers," are now numerous. All the French crayfish vessels contain reservoirs, the water being constantly renewed. The majority of the Danish fishing boats also have reservoirs, which keep the fish alive, and for this reason these vessels are greatly favoured by the German market, in which dead fish is at a discount of 30 per cent. to 40 per cent. Plaice and soles, taken from the Esbjerg reservoirs at midday and carefully packed, reach the Berlin market alive as it opens on the following day.

Once reservoirs were installed on board ship, it was only a step in advance to place them in railway waggons. There are many different systems, of which I will mention two or three. In 1895 Sweden, Norway and Germany employed a kind of boiler-shaped tank bedded in the car, fitted with an apparatus for producing oxygen, a jet of which aerated the sea-water in which the fish were carried, while a filter at the base of the boiler ran off the excrementory products. Recently German inventors have produced a new device. It consists of a simple wooden box, hermetically sealed. At the bottom is a bed of moistened rags, on which the fish are laid. The water evaporates, and the humidity of the enclosed air prevents the gills of the fish from drying. Finally, a series of holes in the cover prevent the pressure from rising inside the box. Fish packed in this way can survive three or four days. Restored to the water, they eat all that is given them. Carriage costs very little if this system is employed, the boxes being extremely light.

The best development may be called "The Ocean at Home." I have already spoken of the reservoirs of the

markets of Geestmünde. There are others elsewhere. One of the largest restaurants in Paris built large aquaria, where the diner had the pleasure of seeing the sole or dab he was about to eat disporting itself in its native element. Such arrangements are too costly to be usual : they belong rather to the laboratory. M. Joseph Jézéquel, keeper of the laboratory of zoology at the Sorbonne, has for some time devoted himself to rearing marine animals in aquaria. He has been able to keep the amphioxus alive for three months, other fish for three years, and has obtained young sea-urchins born in his tanks. The sea-water he employs does not come direct from the sea ; it is stale water, and is purified by the process of putrefaction itself.¹

V

The rapid sketch here given of the fish trade in France and in two great markets, those of Basle and Billingsgate, gives some idea of the importance of the trade in Europe.

The million tons of fish furnished yearly by the North Sea is dispersed in all directions, fresh, salted, smoked, or preserved. Among the seven riverine countries of the North Sea, Germany still consumes far more than she can produce, in spite of the incessant development of her fisheries. Belgium also has recourse to her neighbours. The great purveyors to the world-market are England and Scotland, Norway, Denmark, and Holland.

Germany imports more than 120,000 tons of fish

¹ The water of the excellent though wholly unscientific aquarium of the Crystal Palace, now dispersed, was seldom if ever changed. It was very slowly circulated through dark chambers at the back of the tanks, and aërated by jets of water falling from a height. Many of the fish must have lived thirty or forty years. The best aquarium, if not the only one of any scientific value, in the south of England, is attached to the marine laboratory of Plymouth.—[TRANS.]

annually, for which she pays £1,140,000, £1,000,000 of this being for herring. Denmark alone furnishes the half of this amount; Holland, about a quarter: Norway, Sweden, and Belgium provide the rest. The importation of fresh herring (iced) increases from year to year. From 40,000 tons in 1901 it has increased to 94,000 in 1907, in spite of the activity of the fourteen companies of Emden, Leer, Bremerhaven, Vegesk, Nordenham, Brake, and Gluckstadt, which have trebled their productiveness in ten years.

Switzerland buys the greater portion of her fish from Holland, and the rest from France, Belgium, England, and Germany. The total represents a value of £180,000 a year. Belgium imports nearly £40,000 worth of fish from France, England, and Holland. These same countries export to Russia more than £160,000 worth of fish. "It must be remembered," says M. Roy, and rightly, "that these figures can only be approximate. Part of the fish imported by Germany is re-exported to Switzerland or Belgium. Inversely, England, which is by far the first country on the North Sea, or indeed in the world, in the matter of exporting fresh fish—this exportation amounting to more than £1,600,000 annually—also imports a by no means negligible quantity. Thus in 1906 the North Sea provided the British Isles with "fish other than herring" to the extent of 6,000 tons from Holland, Norway, Denmark, France, Belgium, and Germany, its value being £420,000. "In the matter of herring the case is very different. During a whole season, from January to March, the herring caught on the English coast are scanty in numbers and poor in quality. Consequently the factories of certain of the English ports have to resort to the Scandinavian countries, which are at this time at the height of their

good herring season. In 1906 Norway furnished Hull, the leading port in the matter of curing herrings, with 35,000 tons of fish, worth nearly £240,000."

Austro-Hungary receives the fish she consumes from the great fish-producing countries of the North Sea. She is also a good customer to Italy and Greece. The fishermen of Istria must be included among the most regular providers of Trieste market.

After fresh fish, cured fish: herring and cod. Germany buys each year 200,000 tons of herring in barrels, of the value of £3,600,000, from the British Isles, Holland, Norway, and Sweden. To these 200,000 tons, or 1,295,000 barrels, we must add the national yield of 400,000 barrels. This prodigious quantity of fish is eaten in Germany. In addition to this the merchants of Stettin, Königsberg, Hamburg, Dantzic, and Memel import nearly 1,000,000 barrels, which are at once resold to Austria, Switzerland, and above all to Russia. Stettin re-exports herring even to the United States. Libau supplies St. Petersburg by sea, and Riga the interior of the country and Siberia; and the Russian importation through these two ports amounts to 1,300,000 barrels, worth £1,800,000. The principal providers of the United States are Holland (1,000,000 barrels), the British Isles (900,000 barrels), and then Norway and Germany (180,000 and 40,000 barrels). Holland, the British Isles, and Sweden all export to the States not only herring but also cured mackerel; but they meet with an active competitor in Canada. Finally, the factories of Stavanger export sardines in oil to the States. The ports of entry are New York, Boston, Philadelphia, and Chicago.

Boulogne and Fécamp send 300 tons of red herrings annually to Switzerland. Italy buys of Yarmouth and Aberdeen, Greece of Holland. During the feast of

Ramadan Egypt consumes £80,000 worth of dried or smoked fish, a third of which comes from the United Kingdom.

Let us pass on to the exports of salted cod.

Norway, England, Holland, and France are the great providers of this article. All the countries of Spanish origin, with Spain at their head, eat stock-fish ; Portugal, the Antilles, Brazil, the Argentine ; then Italy, Greece, Syria, Egypt, the United States, and finally Australia.

Spain buys over 20,000 tons of cod annually from Norway. The "baccaleo secco," as the Spaniards term it, is shipped from Aalsund to Bilbao and Vigo. The traffic is considerable, and I was surprised, on visiting the great warehouses of Herr Rönneberg at Aalsund, to hear several Norwegians speaking Spanish.

France and England each export 15,000 tons of cod. The fish consumed in Malaga and the province of Granada are of English and American brands. They are specially prepared so as to keep a long time without deterioration. "For this reason the merchants prefer them, as their stock is safe in case it should remain in the warehouse. It is not the same with French cod. The latter, although a fish of better quality, is prepared with less salt than the English article, which grows hard after being in stock a certain time. The French fish soon depreciates in a high temperature ; red spots appear round the central ridge, which mark the first symptoms of decomposition, due to a degree of desiccation insufficient for warm, damp climates.¹ This article being so largely consumed in the country districts, the

¹ The red spots are due to a cryptogamic vegetation, which can be attacked by means of a 5 per cent. solution of sulpho-benzoate of sodium. The fumigation of the hold of the fishing vessel with sulphur will also act as a preventive.

market now held by England and America might be shared by France if only the French fish were prepared differently. However, in the colder regions of Andalusia the French fish may be imported successfully; and for the last three years a constant though limited supply has been exported to Granada.”¹

Portugal imports 25,000 tons of cod, of which 16,000 come from England and 5,000 from France. The chief centre of importation is Oporto. The rest is furnished by the Portuguese fishermen, who frequent the banks of Newfoundland. In 1903 a few Spaniards and Italians followed them. Italy buys more than 40,000 tons of cod, at a cost of £120,000, from England, Norway, and France.

The shipments of French stock-fish to Brazil are by no means progressing.² “It is largely a question of quality and price. The quality being the same, the sale price of French fish is higher than that of the competing articles. . . . This state of things is due to a lack of organisation on the part of the French shippers, and their lack of understanding of the Brazilian market.”³

¹ Extract from the Bulletin of the French Chamber of Commerce at Malaga.

² Note by M. Charlat, French Vice-Consul.

³ Statistics of the Brazilian market :—

	1906.		1907.	
	Tons. (Metric.)	Value. £	Tons.	Value. £
TOTAL IMPORTS ...	25,932,210	771,960	26,324,223	878,992
From Newfoundland	15,352,125	397,380	14,899,601	439,752
„ Norway ...	4,874,940	188,992	5,031,038	208,160
„ Canada ...	4,291,910	140,320	5,417,331	192,640
„ United States	407,450	12,760	521,986	17,860
„ England ...	705,366	19,840	290,857	12,760
„ France ...	151,310	5,800	44,967	1,635

Finally, Portugal, Spain, Italy, and Brazil buy cod directly from St. John's in Newfoundland. The cod exported by Labrador is known as "Shore-cured Labrador," a very dry but not highly salted fish, exported to Brazil and the West Indies; and "Damp Labrador," a damp and very salt fish, like the French article, with which it competes in the Mediterranean markets. The prices of "shore-cured" tend to rise and those of "damp" to fall from year to year.

If I am reproached with the brevity of this commercial sketch, I must reply that this book is not an encyclopædia. I have given these few figures with the intention of giving some idea of the general trade in fish; and I have tried to show that in spite of the capital importance in the economy of Europe of such largely productive countries as the British Isles, Holland, and Norway, and of such centres as Basle, the fish market is nevertheless very widely dispersed, and that there is a regular interchange of merchandise between the various maritime nations, of which we must look for the prime cause in the narrow localisation of species.

CONCLUSION

THIS book is at once statistical and critical.

It is statistical because it gives the essential facts concerning a number of subjects ; and it asks questions which it does not answer. I have taken care never to divorce the fish from its natural surroundings, and as a basis for the industry of ocean fishery I have given the always exacter knowledge and the more deliberate and thoughtful methods of the fishermen of the coast. The duty of science is to advise, not to direct ; but it must also listen.

This book is also critical, and indeed should be so. It is impossible to write a history of French fisheries without making a survey of the fisheries of other countries ; and as the comparison is not to the advantage of France, it is inevitable that bitter reflections should occur to us. There is no clear-sighted patriot who does not denounce ¹ the tariffs which oppress the merchant marine of France. I am aware that sceptics have made it the fashion to laugh at such prophets of evil ; but such laughter is the sign of a barren mind.

It will be enough to develop this preamble in a few words to show the sequence of the ideas which are embodied in the book as a whole.

The sea is inexhaustible, and there can never be a

¹ No one has done so more powerfully than M. Marcel Dubois in his excellent book, *La Crise maritime*.

general and simultaneous depopulation. The ocean fisheries will always be copious and easy, and their yield will be greater as the ocean becomes more familiar and the methods employed more perfect. But the capital question is of the economic and social order. Our fishermen do not make all they should by their labour, because they are badly organised; their boats and gear are old or old-fashioned, their ports badly equipped, and the capital engaged insufficient.

Here are three reforms to begin with; but it would be rash indeed to hope to see them quickly realised. We must work from the simple to the complex, and begin with what is most urgent. We must begin not with the coast, *but with the interior of the country.*

Let us, in France, begin by opening, and if need be breaking, the gates of the *octroi*. Fish will be cheaper; more will be eaten; the work of the fishermen will be increased, regularised, and more productive. Prosperity will prevail along the coast; and prosperity, the child of labour, is a good counsellor. We shall see the necessary changes in the technique of fishery. The fisherman's position will be stronger and more independent. Then, by the natural action of economic forces, we shall see the insufficiencies of our harbours repaired; we shall see more large harbours and fewer small ones. The railway companies in turn, in face of the increasing shipments of merchandise, will lend an attentive ear to the requirements of the fishermen; their own interests will lead them to meet these requirements.

In other words, we must relieve the congestion of the coast by providing large and numerous outlets; that is, we must urge the consumer to eat more fish and the merchant to ship exports to foreign markets. Why should not the State assist in this work of construction

and reconstruction ? Let it prescribe fish as a habitual article of diet in its barracks and between the decks of its warships. It might well show itself generous in this respect, even though it is asked to perform so many miracles that Providence itself, to which it has succeeded, would have lost its head and gone out on strike !

But do not let us deceive ourselves : it is easier to kill the hydra of Lerna than to open the barrier of the *octroi*. It is of no use for our shipowners, fishermen, and salesmen to take the field unless they are armed and assembled with this precise end in view. They must make up their minds to incessant action, I would almost say to incessant agitation. The victory is too precious to lose for want of ardour in the struggle, and the victory is certain, because it is just.

PRINCIPAL FISHING GROUNDS

- Banks (and fishponds) of the Adriatic, 136-7, 341
- Banks of the Baltic, 89, 135, 279
- Banks, the Atlanto-Saharan, 67-9, 72, 74, 84-5, 285, 307
- Bank, the Dogger, 61, 72-3, 79, 198
- Bank, the Great Fisher, 61, 72-3, 79
- Banks, the Iceland, 65-6, 72, 74, 77-8, 89, 190, 193, 231, 283
- Banks of the North Sea, 59-60, 73, 78-9, 103, 109, 111, 112, 131-2, 153-4, 157, 188, 191, 198, 229, 262, 277
- Banks of the Continental (Atlantic) Plateau and the Channel, 54, 72, 77, 79, 102, 107, 140-5, 161, 165, 198, 227, 263
- Banks of the Mediterranean, 58, 73, 83, 102, 113, 128, 182, 227-9
- Banks of Newfoundland, 62, 72, 73, 89, 151, 231, 283

(See also Index.)

PRINCIPAL FISHING PORTS

Aberdeen, 215, 232, 277, 313
Arcachon, 208, 210, 211, 230-1, 233, 304
Boulogne, 209, 211, 226, 232, 246, 251-3, 313
Cuxhaven, 216, 218, 221
Fécamp, 209, 211, 224, 226, 247, 313
Geestmünde, 217, 221, 313
Grimsby, 211, 212, 214-5, 277-8
Hull, 214-5, 336
Ijmuiden, 218, 221
La Rochelle, 230, 314-5
Le Havre, 199-201, 315

(See also Index.)

BIBLIOGRAPHY

BIBLIOGRAPHY

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SUBJECT INDEX

SUBJECT INDEX

- ABERDEEN**, 203, 215, 216, 277,
 313
Adriatic, banks and fishponds of,
 136, 137, 341
Adult fish, sizes of, 125, 126
Arcachon, 208, 230, 231, 233
 Fishponds of, 140-2
 Sardine-fishers of, 204
 Types of harbour, 206
 Arrangement of port, 210, 211
 Motor fishing-boats of, 304
 Trawling fleet of, 306
Ascension Isle, 66
Atlantic Ocean—
 Fish of, 28, 30
 Physiology and currents of, 77,
 78
 Plankton of, 93
 Plateau, 54-7
Austria, imports of, 341
Azores, 66
Azote, combinations and functions
 of in sea-water, 97, 98, 153,
 154

BALTIC—
 Banks of the, 89, 135, 279
 Waters of the, 169, 170
Banks, fishermen's, 255-8
 Banks (fishing-grounds), 54-69
 The African, 67, 163, 178
 The Algerian, 163
 The Arguin, 67, 85, 178
 The Atlantic Continental Plateau
 (and Channel), 54-57, 72, 77,
 79, 102, 107, 140-5, 161, 165,
 198, 227, 263
 The Atlanto-Saharan, 67, 68, 72,
 74, 84, 85, 182, 285, 307
 The Baltic, 89, 135, 279
 The Dogger, 60, 61, 72, 73, 79,
 198, 283
 The Great Fisher, 61, 72, 73, 79
 The Iceland, 59, 65-7, 72, 74, 77,
 78, 89, 182, 190, 193, 231,
 283, 284
 Of the Baie du Lévrier, 57, 68,
 69, 72, 85, 285
 Of the Mediterranean, 58, 73, 83,
 102, 113, 128, 182, 227-9
 Of Morocco, 59
 Of Newfoundland, 59, 61-5, 72,
 73, 89, 151, 177, 182, 231,
 283, 285
 Of the North Sea, 59, 60, 73, 78,
 79, 103, 109, 111, 112, 131,
 132, 153, 154, 157, 188, 191,
 198, 229, 262, 277
 Of the White Sea, 163

Basle, market of, 335, 336
 Billingsgate, 336, 337
 Boats, 224-243—
 Sailing vessels, types, 234, 235
 Line-fishing boats, 231
 Steam trawlers, 250-3
 Ratio of steam to sailing vessels,
 265
 Yield of, 206, 207
 Best size of, 268
 History of development, 269
 Profits of, 270, 271
 Boulogne, 203, 206, 233, 308,
 313
 Fisheries of, 207, 208
 Port of, 209
 Wages of fishermen, 246, 251-
 53
 Profits of fisheries of, 270, 271
 Fish market of, 314
 Brazil, exports to, 343
 Breeding, *see* Piscifaculture
 Breton fishing villages, 203
 Breton fishermen, obstinacy of,
 289, 290
 Buch, Captaux de, sell salt-marshes
 for fishponds, 140, 141

CANADA, fisheries of, 281
 Canaries, the, 68
 Cape Blanco, 68, 69
 Cape Verde Islands, 68
 Channel, the—
 Fish of, 28, 30
 Temperature and salinity, 72
 Tidal currents in, 79-81
 Yield of, 263
 Charts, fishery, 157

Cod—
 Bred at Flödwig, 148, 150
 Habits, 169
 Early Newfoundland fishery for,
 177, 344
 Co-operative societies, 255-8, 322-
 24
 Credit, maritime, 255, 256
 Currents, their part in the forma-
 tion of plankton, 94-6
 Currents—Ocean—
 The African, 84, 85
 The Cabot, 62, 65, 183
 The Equatorial (North), 85
 The Gulf Stream, 62, 77, 78,
 188
 The Irminger, 77
 The Moorish, 84, 85
 The Polar, 62, 183
 The Rennell, 77
 See Tides
 Vertical, 25, 83, 183
 Cuxhaven, 216, 218, 221

DAMS, 135, 136
 Denmark, fisheries of, 134, 135,
 216, 279
 Destruction of fish (101-16)—
 By voracious fish and mammals,
 104-6
 By small fishermen, 106
 By dogfish, 105
 By nets, 114-6
 Dieppe, 208

ENGLAND—
 Annual catch of, 273
 Steam trawlers of, 294-9
 Esbjerg, 216

Explosives, abuse of, 107

Exports, French, 334

FÉCAMP, 203, 206, 209, 211, 224,
226, 247, 283, 313

Feeding of fish—

In relation to spawning and
migration, 24

In fishponds, 175, 176

Feeding-grounds, 24, 70-100

Fish—

Classification of, 21

Reproduction of, 22

Food, 23, 24

Characteristics of, 27

Location of principal market-
able species, 28-30

List of marketable species, 31-
53

Geographical modification and
distribution of species, 167

Voracity of, 134, 135

Individuality of, 180, 181

Fisheries—

Cod, 190, 208, 263, 283, 286

East coast, 277

French, history of, 199, 200

Value of, 281, 282

Evolution of, 294-311

Herring, 190, 207, 226, 237, 263,
290, 291

Iceland, 225, 283, 284

Mackerel, 247, 291, 292

Newfoundland, 177, 178, 202,
253, 284, 285

Sardine, 208, 239, 250, 286-90

Tunny, 292

Conditions of prosperous, 193

Fishery—

Laws, 117-26 ; *see* Laws

Problems, 165-94

Schools, 159, 160

Fishermen, methods of profit-
sharing among, 244, 251,
245-7, 248-51

Fishermen's unions, societies, &c.,
254-60

Fishing-grounds, 54-69

Distant, 59

Depopulation of, 101-16

New, 162, 163

Depths of, 166

Definition and causes of, 183,
184

Law of, 187, 188

Fish-marshes, 141

Fishponds, 55, 134-47

of Arcachon, 140

of Comacchio, 136

of Marennes, 144

of Uddevalla Fjord, 138

of the Rhone, 138

of Sables d'Olonne, 144

of Vendée, 138

English, 146

Various, 144

Construction of, 141, 142

Management of, 143

Fish reared in, 143

Profit of, 144-47

Food given, 165, 166

Yield, 264, 275, 280, 281

Fuglasker Islands, 65

GEAR, kinds of, 233-43

Geestmünde, 207, 217, 218, 221,
252, 278, 312, 313

Germany—

Fisheries of, 278

Fish trade of, 339

Grimsby, 199, 206, 215, 277, 278

Port of, 211-14

Gulf Stream, 62, 77, 78, 84

HATCHERIES, *see* PiscifacultureHavre, early history of, 199-201,
315

Herring, 25, 166, 167

Habits of, 169, 177, 184, 185, 190,
200, 263, 267, 277, 290, 313,

314

Hull, 214, 215, 278, 336

ICE, *see* RefrigerationIceland, *see* Banks of

Ijmuiden, 218, 221

Imports, French, 334

Inscriptions, naval, 259

Insurance and invalidity societies,
254-7

Irminger Sea, 89

Italy—

Fisheries of, 280, 281

Trade of, 341

JAPAN, fisheries of, 281

LA ROCHELLE, 230, 314, 315

Laws—

Fishery, 117-26

Of territorial limits, 117-19,
124, 125Respecting trawls, 118, 119,
121Respecting sizes of fish, 125,
126

Laws—

Respecting sizes of cabins,
261Respecting steam trawlers,
296-8Le Havre, *see* Havre

Lévrier, Baie du, 59, 68, 69, 72

Lines, 234, 241, 242

Lowestoft, *see* YarmouthLümfjord, nursery of plaice, 134,
135

MACKEREL, 170, 247, 291, 292

Marked fish, movements of, 130-
32

Markets, 312-24

Heavy dues of, 314-20

At Boulogne, 314

Methods of sale, 314, 321, 322

Of Paris, 330-33

Of Basle, 335

Of Billingsgate, 336, 337

Massigli's law, 75

Mediterranean—

Floor of the, 58, 59

Yield of, 263

Migration—

Of fish, before spawning, 24

Of fry, 25, 109

Of marked fish, 130-32; 166,
168, 187

Mimicry, 176, 177

Moray Firth, closing of, 122, 123

Motor-boats, 299-306

Of France, 299-300

Of Denmark, 300

Cost of fitting, 301, 303

Alcohol or petrol, 304, 305

- NETS, 233-43**
 Crawl-, 240
 Curtain-, 107
 Drift-, 234, 238, 239, 241
Madrague, 240, 280, 292, 293
 Seine, 107, 234, 280, 289
 Stake-, 107
 Trap-, 239
 Trawl-, 234
 Bag trawl, or *ganguis*, 112, 113, 236, 237
 Beam trawl, 236, 237, 296
 Otter trawl, 108, 109, 111, 112, 235, 243, 295
 Shrimp trawl, 113, 237
 Newfoundland, 65, 177, 178, 202, 259, 344
See Banks of
 North Sea—
 Fish of, 28-30, 78
 Tides in, 79, 80
 Plankton of, 93
 Diminution of fish in, 103, 104
 Plaice of, 132, 133
 Productiveness, 153
 Floating population of, 198, 339
See Banks of
 Permanent International Council for Exploration of, 154-56
 Norway—
 Fishermen of, 202
 Fisheries, 279
 Norwegian dike, the, 60
 Norwegian flag, abuse of, 123
Octroi, evils of, 310, 315, 316, 318, 320, 344, 346, 347
Œcumene, social, the, 197-204
- PENSION FUNDS, 259**
 Petrol, *see* Motor-boats
 Piscifactory, 148-53
 Theoretical profits of, 150
 Technique of, 152, 153
 Plankton, 86-100
 Composition and origin of, 86-91
 Distribution, 91
 Accumulations of, 92-4
 Formation of, 94, 95
 Vegetable, 96
 Chemical and physical functions of, 97-100, 149
 Immense accumulations of, 171, 172
 Police, fishery, 119, 120
 Ports—
 Fishing, 198, 199, 205-23
 French, 208
 European, 211
 Equipment and administration of, 220
 Portugal—
 Fisheries of, 280
 Trade of, 343
 Problems, 165-94
 Profits—
 Systems of sharing, 244-51, 262-75
 Table of, 270-1 ; 272-5, 277
- RAILWAYS, *see* Transport**
 Red Sea, 92
 Refrigeration, 306-11, 307, 336, 338
 Replenishment of fishing grounds, 127-47
 Direct method, 153

Reservations, 120-22

In Moray Firth, 122-24, 127-47

Definition of, 127

Two kinds, 129, 189

Rocks, 56

Roscoff, 201, 202

SALINITY, 70-74, 169, 170

Salmon, 26

Salt fish, 306

Sardines, 172-74, 178, 179, 184,

280, 286-90, 312, 313, 334

Schools, fishery, 159, 160

Science and fishery, 148-64

Scientific societies, 154, 160

Scotch ports, 277

Scotland, Fishery Board of, 188,

189

Sea-meadows, 55

Destroyed by trawlers inshore,

109

Sea-water, chemistry of, 98, 153,

154

Seine, *see* Nets

Seine, River, 55

Skagerack, the, 22, 60, 81, 169

Social life of fishermen, 197-204

Soles, breeding of, 151, 152, 149,

175

Spain, fish trade of, 342

Spawning, 22, 104, 109, 110, 184,

185

Steam trawlers, 108, 109, 230-33

History of, 294-99

Complaints against, 295, 296

Swiss fish trade, 340

TEMPERATURE—

Of sea-water, 71

Supported by fish, 172-74

Effect on movements, 186

Cold fatal, 190

Territorial limits, 117-19

Tides, 79-82

Trade, international, 335, 336

Transplantation of fish, *see* Replenishment

Transport—

In France, 311, 325

Cost of, 326, 327

In Germany, 328

In England, 328, 329-31

Trawling, 184, 191

Steam, 230-33, 265-67

History of developments, 294-99

Tristan d'Acunha, 66

Tunny, 292, 293

VENICE, fishponds of ancient and modern, 135, 136

Voracity of fish, 174, 175

WEIRS, 135, 136

Wages, 248-51, 259

Whale fishery, Norwegian, 280

Whaling, 201

Wyville Thomson Ridge, the, 66

Effect of, 77, 78, 183

YARMOUTH, 215

Profits of, 277

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