Hydrographical Studies.¹

HYDROGRAPHY is a backward science, and the very ocean, scientifically speaking, is a neglected field. Mr. J. Y. Buchanan, an oceanographer himself, tells us so in his new book of "Accounts Rendered":—"It seems almost incredible that the men of all nations, burning with scientific and exploring zeal, should have entirely overlooked, and apparently despised, this large portion of the world." Our *Challenger* Expedition had two faults: it cost a great deal of money, and it was done too well. It has led two generations of Englishmen to believe that the thing was done and need not be repeated, and must on no account be asked for again. Yet, in spite of this great old expedition of ours, and the various scientific exploring voyages of the *Travailleur*, the *Gauss*, the *Siboga*, the *Albatross*, the *Thor*, and all the rest which have followed it (in other hands than ours), we know perfectly well that our knowledge of the ocean, both physical and biological, is in its merest infancy. Its fauna we know as we knew that of the shore fifty years ago, a handful here, a handful there, of its physical and physico-chemical phenomena we know a great deal less.

Nor is this true only of the wide oceans. Twenty years ago we knew, to all intents and purposes, absolutely nothing of the hydrography of the North Sea itself with the one exception of its tides. Its temperatures and densities had never been mapped, their seasonal fluctuations (save at a few shore-stations) were unknown. Even in regard to the tides, and in spite of the great men who have devoted themselves to this favourite subject, we know that we have still a vast deal to learn in theory, and that in practice our tide-tables fall short of the accuracy which modern conditions demand. Things are beginning to mend. The University of Liverpool has established, not only a chair of oceanography, but also a special institute for the study of the tides; and, under the stimulus of international co-operation, a certain aspect of hydrography has come to be an intrinsic part of the scientific work of our fishery departments.

All this is to the good, though not yet nearly enough. The fishery departments are working on imperfect material, with inadequate staffs and still more inadequate laboratories; but better days are coming. Even in these hard times the work will go on, and under much better conditions than before, but we shall scarcely be satisfied! For the physical study of the sea is a very great thing indeed. Of its problems many are scarcely formulated, many others doubtless are still unforeseen. There is no end to them; they range, let us say, from the study of the tides to that of hydroxyl-ion concentrations, from the movements of the great ocean currents to the coefficients of absorption of the sun's rays in the surface-waters of the sea—nay more, they may involve the most fundamental questions of chemical physiology, in relation to the life and the nutrition of one grade of organisms after another. They call, or ought to call, for the widest physical and chemical knowledge and high mathematical skill. Not only must the officials of a department do their daily task, but still wiser and more learned heads must play their part.

There is not one of these problems which has not its practical side—its influence direct or indirect, on the lives of fish and the lives of men. But the prac-

tical outcome of our knowledge lies, for the most part, a good long way off. The tanner, the dyer, or the brewer, the maker of soap or of glass, even the farmer and the gold-digger, come straight to the chemist with their troubles, for they have learned at last that it is worth their while; yet even now when they do so, as often as not the questions they put only suggest a new line of investigation, instead of finding an answer to hand. And chemistry is all but the oldest of the sciences, while hydrography is a thing of yesterday—or rather of to-morrow.

But I have left myself no room, after all, to discuss as they deserve those of Dr. Jee's papers published by the Department of Agriculture and Fisheries. They form a diligent and meritorious contribution to the necessary statistics of hydrography. They set forth fully and clearly (1) the variations of temperature and of salinity during a considerable number of years at the Seven Stones Lighthouse, a station of very obvious importance in the neighbourhood of the Scilly Isles; (2) the same phenomena on a cross-section of the English Channel, from the Isle of Wight to St. Malo; and (3) the same again for the surface-waters of the North Atlantic, in a particular area where warm currents appear to branch off for the ultimate supply of the southern and the northern portions of the North Sea. The data, which are very numerous, are furnished by captains of ships and the keepers of the lighthouse; and Dr. Jee's business has been to reduce to order, to analyse, and, above all, to discuss this large mass of observations. The phenomena so elucidated, and the deductions drawn from them, are too numerous to be discussed here.

On one curious point, and one only, we may say a word. Dr. Jee pays a good deal of attention to a favourite theory of certain meteorologists (Dr. Otto Pettersson among them) that there is a marked alternation of temperatures between the "odd" and the "even" years; that there is at least a *tendency* for the years of even number to be warmer than the odd. Dr. Jee finds considerable support for this theory in the surface-waters of the sea, but subject to curious limitations. He tells us that "it is a fact of undoubted significance that, for a very wide stretch of the Atlantic extending from the coast of Cornwall at least as far as 35° W., the November means are in the aggregate of substantially higher value in the years of even number, and that this value culminates in the area of maximal temperature. . . . This periodicity is a general feature of the waters of the Atlantic east of 35° W., and the persistence of its occurrence is amply demonstrated by the zonal means, which *regularly alternate* high in the November of an even year and low in the year following."

There is here, in short, some definite evidence adduced bearing on the important question of a regular two-year "pulse" of the Gulf Stream. But during other parts of the year exceptions become perplexingly numerous, and Dr. Jee himself tells us that "examination of the monthly means . . . shows that only in November do they exhibit any appreciable conformability to the odd and even rule." Even if the phenomenon were only clearly manifested in November (in this particular region), it might still be of great importance, and we should like to know a great deal more about it. The fact that we are left without a firm hold of the thing is not Dr. Jee's fault at all, but depends on the fact that he is still only able to deal in detail with a particular and limited area. A similarly detailed account of the surrounding areas would soon, I imagine, convince us whether we were dealing with a real phenomenon or not, and if it confirmed would begin to help to explain it.

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¹ Board of Agriculture and Fisheries: Fishery Investigations. Ser. III. Hydrography. Vol. i., "The English Channel," Part ii.; Vol. ii., "Lightship Observations," Part i.; Vol. iii., "The Atlantic Ocean," Part i. By Dr. Edwin C. Jee. Hydrographer on the Staff of the Board. (H.M. Stationery Office, 1919.)