of water fall on any part of it where it showed white when breathed on. Now tilt the plate to make the drop flow, and note the resistance to its flow, and how it draws itself up in the rear, leaving the plate dry. When, however, the moving drop comes to the part acted on by the flame, all resistance to flow ceases, and the drop rapidly spreads itself over the whole track, and shows a decided disinclination to leave it."

The impression thus produced lasts for some days or weeks, with diminishing distinctness. A permanent record may be obtained by the deposit of a very thin coat of silver by the usual chemical method. The silver attaches itself by preference to the track of the flame, and especially to the *edges* of the track, where presumably the combustion is most intense. It may be protected with celluloid, or other, varnish.

The view, expressed by Mr. Aitken, which would attribute the effect to very fine dust deposited on the glass from the flame, does not commend itself to me. And yet mere heat is not very effective. I was unable to obtain a good result by strongly heating the *back* of a thin glass in a Bunsen flame. For this purpose a long flame on Ramsay's plan is suitable, especially if it be long enough to include the entire width of the plate.

It seems to me that we must appeal to varying degrees of cleanliness for the explanation, cleanliness meaning mainly freedom from grease. And one of the first things is to disabuse our minds of the idea that anything wiped with an ordinary cloth can possibly be clean. This subject was ably treated many years ago by Quincke (Wied. Ann. II., p. 145, 1877), who, however, seems to have remained in doubt whether a film of air might not give rise to the same effects as a film of grease. Quincke investigated the maximum edge-angle possible when a drop of liquid stands upon the surface of a solid. In general, the cleaner the surface, the smaller the maximum edge-angle. With alcohol and petroleum there was no difficulty in reducing the maximum angle to zero. With water on glass the angle could be made small, but increased as time elapsed after cleaning.

As a detergent Quincke employed hot sulphuric acid. A few drops may be poured upon a thin glass plate, which is then strongly heated over a Bunsen burner. When somewhat cooled, the plate may be washed under the tap, rinsed with distilled water, and dried over the Bunsen without any kind of wiping. The parts wetted by the acid then behave much as the track of the blow-pipe flame in Aitken's experiment.

An even better treatment is with hydrofluoric acid, which actually renews the surface of the glass. A few drops of the commercial acid, diluted, say, ten times, may be employed, much as the sulphuric acid, only without heat. The parts so treated condense the breath in large laminæ, contrasting strongly with the ordinary deposit.

It must be admitted that some difficulties remain in attributing the behaviour of an ordinary plate to a superficial film of grease. One of these is the comparative permanence of breath figures, which often survive wiping with a cloth. The thought has sometimes occurred to me that the film of grease is not entirely superficial, but penetrates in some degree into the substance of the glass. In that case its removal and renewal would not be so easy. We know but little of the properties of matter in thin films, which may differ entirely from those of the same substance in mass. It may be recalled that a film of oil, one or two millionths of a millimetre thick, suffices to stop the movements of camphor on the surface of water, and that much smaller quantities may be rendered evident by optical and other methods. RAYLEIGH.

NORTH SEA FISHERY INVESTIGATIONS.[1]

THE third Report on the Fishery and Hydrographic Investigations conducted by the Marine Biological Association under the international organisation is the most interesting yet published. It contains statistical papers dealing with the abundance and migrations of edible fishes in the North Sea; the age and growth-rate of plaice from the same region; and the fishing action of trawl nets with respect to the size of mesh. There are also accounts of the distribution of fish-eggs in the North Sea during the summer, and of the physical conditions of the water of the English Channel, and its contained plankton throughout the year 1906.

The first, and most lengthy, paper in the Report is one of unusual interest and value. In it Miss R. M. Lee has summarised and discussed a series of records kept by the masters of nine Grimsby steam trawling vessels, which fish over the whole of the central part of the North Sea. These records cover the period 1904–8, and represent the results of 14,543 hauls of the otter trawl net, which means about 53,995 hours' fishing. The statistics have been treated most clearly and concisely, and show for each of twenty-three areas into which the whole North Sea has been divided, the monthly average quantities of each of the more important species of marketable fishes caught by the vessels per ten hours' trawling. In order to render these results comparable with those obtained by other statistical workers (Fulton, D'Arcy Thompson, Redeke), the author has calculated factors which enable one fishing unit to be converted into any of the others used.

From these data (which are based on the practical knowledge acquired by a number of very experienced fishermen) Miss Lee has deduced the general distribution of each of the species of fish considered over the whole area of North Sea represented, the migrations from one subarea to others, the spawning movements of the fishes, the variations in density from month to month, and the general change in the productivity of the fishing grounds from year to year. Her paper, and a former one which dealt in a similar way with records kept by a number of Lowestoft sailing-trawler skippers, form a picture of the present condition of the North Sea fishing area which must prove to be of inestimable value for the fishery administrators of the future. If, in the early 'seventies, before steam trawling had become the predominant method of fishing, such a summary by a trained statistician had been made, how much controversy and trouble might have been avoided! Even as it is, a comparison of Miss Lee's results with those imperfect records which we possess of fishery operations in the North Sea in the 'seventies and 'eighties shows most strikingly the change which has taken place, and enables us to realise, to a degree hitherto unattainable, how very great must have been the diminution of the stock of fish inhabiting the North Sea. It is not a question of the decadence of a fishing ground, but rather the fishing-out of an accumulated stock, and the establishment of a new equilibrium, on a lower level, between the natural powers of recuperation of a fish population and the catching power of the British and Continental fishing fleets. And there can be little doubt that, in the absence of concerted measures for cultivation, this equilibrium must settle down to still lower levels. It is sincerely to be hoped that this work may be continued by Miss Lee.

Dr. Wallace has continued his former work on the natural history of the plaice and subjects to detailed analysis, a mass of data representing individual deter-

[1] Third Report (Southern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1906–8. [Cd. 5546]. 1911.

minations of length, sex, age, and weight of over 20,000 plaice from various North Sea fishing grounds. The results show clearly that the conditions with regard to nutrition vary from ground to ground, and they suggest that a knowledge of these conditions may, in time, enable fishery authorities to increase the productivity of the North Sea by the "transplantation" of fish from grounds on which the growth is slow to other grounds on which the conditions of life are more favourable. Dr. Wallace's paper supplements that of Miss Lee in that it gives us data which cannot be obtained by ordinary methods of commercial statistics, and which are quite essential for the proper understanding of the latter.

Mr. Todd's experiments on "covered nets" are designed to elucidate the fishing action of the trawl net in respect of the numbers and sizes of fish which escape capture by the mesh employed. The outside parts of the trawl nets used have been covered by other loose nets of narrower mesh, and the fish which have escaped capture by the inner wide-meshed net are intercepted by the outer narrow-meshed net. Mr. Todd tabulates and discusses the results of a number of such experiments.

Mr. Wollaston gives an account of the first cruise made by an English vessel expressly for the purpose of determining, by means of specially constructed nets, the distribution of fish-eggs in the open sea. The cruise was made in June, 1909, in the North Sea, by the vessel *Huxley*, and tables are given which show in detail the results of the experiments made at each observation station, while synoptic charts represent the numbers and distribution of the eggs of certain species of summer-spawning fish present per square metre of sea surface in the neighbourhood of the stations. By far the most interesting part of Mr. Wollaston's paper is that devoted to a description of the methods employed. The net was specially constructed, and its "constants" were calculated so that it was possible to estimate approximately the average volume of water which was filtered through its meshes. Welcome improvements in the methods of preservation of the fish-eggs caught, so as to avoid distortion, and obscuration of finer details of structure have been developed. The author then proceeds to apply the methods of modern biometricians to the analysis of his data. It has hitherto been impossible, in work of this kind, to avoid the confusion of eggs belonging to closely allied species, since in some cases a fish-egg can only be identified by measuring its diameter, and that of the contained oil globule. In some pairs of species these pairs of characters overlap, and it was an error of this nature that vitiated (to some degree) the results of Hensen's famous North Sea cruise of 1895. Mr. Wollaston, however, elaborates a mathematical method whereby the eggs belonging to two such overlapping species can be separated. If in a number of examples of the eggs of one species two measurable variable characters, such as the diameters of the egg and oil globule, be determined, then the frequencies of these two variables can be represented by an equation, which is that of an elliptic "correlation surface." But a group of eggs may include two species allied together in that the diameters of the eggs and those of the oil globules do not differ greatly; nevertheless it is only by these characters that the eggs may be recognised. In such a case the correlation surfaces overlap. Mr. Wollaston then shows that it is always possible, by means of relatively simple mathematical methods, to decompose the compound correlation surface so obtained; and to estimate with a very fair degree of probability the actual numbers of each species of egg in the group. We believe that this method is quite a novel one.

The plankton and hydrographic investigations relate to the year 1906. Mr. Bygrave has given the usual tables recording the distribution and relative density of the planktonic organisms present in the Channel in that year. He shows that the density of oceanic plankton may be correlated with the salinity of the water. The seasonal changes taking place in the abundance of the plankton are also discussed, and the author adopts Brandt's hypothesis, according to which the spring maximum of density of Diatom and Peridinian plankton is the result of the accumulation of food-stuffs in the water during the preceding winter months, while the summer minimum is due to the activity of denitrifying bacteria, which decompose nitrogen compounds, so that the latter cannot be used up by the diatoms.

The hydrography of the English Channel is discussed by Mr. Matthews in a short paper of great general interest. An account, illustrated by charts, of the salinity and temperature variations during the year 1906 is given, and the author then discusses the results of calculations of the mean salinities during the years 1903–9. He shows that in addition to the annual salinity variation, there is a two-yearly periodic change, of such nature that the "even" years are characterised by a high range of salinity variation, while in the "odd" years the range of variation is low. The annual and biennial periods are superposed on a longer one, probably twelve-yearly. These discussions anticipate a further paper, which promises to be one of very great interest. J. JOHNSTONE.

A ONE-VOLUME NATURAL HISTORY.[1]

TO compress even a sketchy account of the leading types of existing animals into a small octavo volume of just over 560 pages, and that illustrated by a number of relatively large figures, is a task of stupendous difficulty. In the present instance the author has increased the difficulty by introducing—

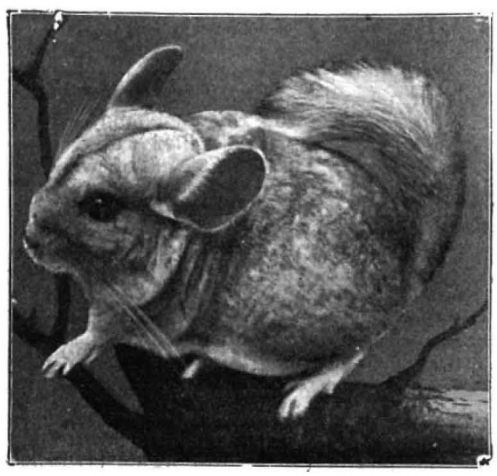

FIG. 1.—A Chinchilla. From the "New Illustrated Natural History.

probably in accordance with what I believe to be a mistaken notion on the part of publishers—a number of anecdotes, which merely waste space. This may perhaps account for the very imperfect diagnoses of most of the groups and species, which appear in many cases insufficient for their identification by those who

[1] "New Illustrated Natural History of the World." By E. Protheroe. Pp. xx+564. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7s. 6d. net.