

but provide favourable conditions for others which are able to reach a biological equilibrium. The important exception, which has not yet become extinct nor reached a state of equilibrium with the environment, is man himself. If he does not apply his knowledge of biology to solving his own biological problems on a very large scale without loss of time, he may well come to realize the truth of the sun-dial motto, "It is later than you think".

The style of this book, written and first published in the United States, naturally has an American flavour. The editing of this British edition is, however, irregular—the caption of the picture illustrating the capercaillie gives the bird's name as 'wood grouse', and that of a skua has not been translated from the American 'jaeger'. The name 'cockroach' appears in all its horrid nakedness alongside 'roach', emasculated in deference to American prudery.

The beautiful photographic illustrations, many of them in colour, add greatly to the attractiveness of the book. But the author has suffered, as have many others, from the photographs having been collected, as he acknowledges, by the editors, who presumably have supplied the captions which unfortunately contain some errors. The 'living zooplankton' is manifestly a preserved dead sample; the nesting 'fulmars' are herring gulls; the Brazilian 'horned frogs' are toads and are not as stated 'strictly aquatic'; the flamingos in Lake Nakuru are feeding on surface plankton, not "reaching down into the mud"; the Amazonian tapir is not an "odd relative of the elephant"; the 'topi' in Nairobi Park are not topi (*Damaliscus*) but kongoni (*Alcelaphus*) . . . and so on. It is a pity that these blemishes have been allowed to disfigure an otherwise splendid and fascinating book.

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AT THE TURN OF A TAP

Salt Water Purification

By Prof. K. S. Spiegler. Pp. ix + 167. (New York and London: John Wiley and Sons, Inc., 1962.) 57s.

THE inhabitants of the British Isles are apt to take for granted the supply of fresh water on tap and are prone to complain about the excessive rainfall. Water of drinking quality is generally available for all domestic purposes and, at slight extra charge, for car-washing and garden watering. Probably ten times as much water as is thus consumed is used in addition for irrigation and for industrial purposes to provide us with the needs of an industrial society. It is therefore not surprising that Manchester, with its high concentration of industry, is forced, despite its reputedly high rainfall, to seek additional supplies of water from Wales and the Lake District. The fact that the rich farm lands of Essex would benefit from the equivalent of another eight inches of rainfall is probably less well known. The general shortage of water in this area may indeed limit the growth of new towns there. There is an evident need to conserve water by persuading industry of the necessity of recovering and re-using its process and rinse waters and by reducing to a minimum the pollution of the rivers and lakes from which supplies are drawn.

If conservation of water is important in Britain, it is still more vital for the arid areas of the world, which are being opened up in the search for natural gas, oil, and minerals, and in response to the ever-growing pressure of world population. Some of these areas are not far removed from the sea, but, although the oceans represent a vast reservoir of water, it is too salt to drink since it contains about seven times as much salt as can generally be tolerated for this purpose. At the same time, the rainfall which supplies our fresh water has resulted almost entirely from the evaporation of water from the

sea and its subsequent condensation in the cooler parts of the atmosphere to form clouds. In seeking to supplement his supplies of fresh water in the arid regions, man has inevitably turned to local brackish waters or to sea-water as the source of supply. However, while the random supply of rain water at the whim of Nature costs us nothing, apart from impoundment and distribution, the separation of fresh water from salt water involves an irreducible minimum of energy, which is exceeded by a substantial margin in practice, thus making the process a doubtful economic proposition. Only where the need for fresh water is the overriding consideration, as in parts of the Persian Gulf area, Israel, or Libya, or where the problem of storage is the decisive factor, as in Guernsey, has much use been made of salt water sources.

Prof. Spiegler's book *Salt Water Purification* is concerned not only with the problems outlined here, and to an extent which reveals his concern for humanity, but also with the ingenuity that has been brought to bear on their solution. In this latter aspect he reveals the clarity of thought and exposition which characterizes him as a scientist. His aim of providing "an understanding of the essentials of salt water purification in simple terms for all those interested in the field" has surely been achieved. The scientist or engineer will certainly find in the book a useful overall survey of the problem, while the statesman or economist will find in it an adequate background to enable him to appreciate the fundamental principles involved and a guide to the jargon of the technologist. The text, diagrams, and tables are easy to follow and should not present any great difficulties to the layman.

The first three chapters deal with the basic problems of salt water purification, including the underlying thermodynamic considerations. In the fourth chapter the problem of scale-formation, which occurs in most of the distillation methods and in electro dialysis, is discussed in detail. Of the four chapters which follow, one is devoted to each of the methods of distillation (including multiple effect, flash, vapour compression, and solar), electro dialysis, freezing, and ion-exchange. In each case the practical considerations, the advantages, and the disadvantages are fully discussed. Miscellaneous methods, including solvent extraction, ultrafiltration, osmionis, and critical pressure distillation which, although feasible on a laboratory scale, have not for various reasons been felt of sufficient promise to justify large-scale tests, are briefly discussed in chapter nine. The final chapter of summary and conclusions underlines the problems of assessing the relative costs, not only of producing fresh water from salt as compared with the transportation of the former from the nearest available source, but also of the various processes of desalting. So much depends on the scale of operation and on purely local considerations such as the sources of energy available. An appendix gives a rather more detailed treatment of energy considerations and a table of unit conversions, and there is a useful bibliography.

Frequent references are made in the book to the extensive contributions to this field of the Office of Saline Water, U.S. Department of the Interior. Those who are surprised at the relatively few references to British work may be interested to read the report of a lecture given recently by Dr. Miller of the Water Research Association to the Royal Society of Arts (*J. Roy. Soc. Arts*, 112, 491; 1964) in conjunction with Prof. Spiegler's book.

I myself hope that many others will read this book with as much interest as I have done. Concern for our fellow men should prompt our interest in the problems of the arid regions, but the general problems of water conservation are coming even closer to our doorstep.

The importance of this topic is further underlined by the report (*The Times*, June 25) of the United States and Soviet Governments' joint research project.

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