work in the field, particularly that of Anderson and Nagaoka and recent Russian contributions. Some unnecessary illustrations, such as the three successive pages of pictures of somewhat pedestrian electronics, could well have been omitted. It is not easy to see why these papers have been collected in a single, highly priced volume, when they could have been published in a scientific journal.

B. A. THRUSH

A STUDY OF NON-LINEAR PROBLEMS

Nonlinear Problems in Random Theory

By Prof. Norbert Wiener. (Technology Press Research Monographs.) Pp. ix+131. (Cambridge, Mass.: Technology Press of the Massachusetts Institute of Technology; New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1958.) 36s. net.

THIS is a collection of lectures reproduced by participants of a course given by Prof. N. Wiener at the Massachusetts Institute of Technology. The lectures were recorded by means of a tape-recorder and thus the volume includes the author's spoken words; photographs of formulae actually written down on the blackboard are reproduced. The resulting informal style fits very well with the contents; there is a wealth of ideas and suggestions, both on theory and applications, but the mathematical reasoning is often somewhat incomplete.

The book deals with non-linear functionals of the sample functions $x(t)$ of a stochastic process, which for the most part is the Brownian motion (Wiener) process. Starting with a description of that process, the author then studies certain homogeneous 'polynomial' functionals $H_n(x) = \int \dots \int K_n(t_1, \dots, t_n) dx(t_1) \dots dx(t_n)$ and their expectations. With the help of an orthogonalization process, which makes such homogeneous functionals of different degree orthogonal to each other, a theory of expansions of arbitrary functionals in terms of homogeneous ones is developed. This is the main tool for the evaluation of the autocorrelation function and the spectrum of special functionals suggested by some applications. Frequency modulation problems, for example, lead to functionals of the type $\exp(i\int \dots \int f(t + \tau_1, \dots, t + \tau_n) dx(\tau_1) \dots dx(\tau_n))$. Comparing the computed spectrum with the spectrum observed in electroencephalography, the author offers as a model for the generation of brain-waves certain non-linear oscillators excited by a random input. The same methods are used in the discussion of the analysis and synthesis of non-linear networks, where the author first gives reasons why it suffices, in a sense, to consider a Brownian (shot-effect) input. Here, as well as in the preceding lecture, experimental details are briefly discussed.

The author outlines in a rather sketchy way connexions between the Brownian motion process on one hand, and quantum mechanics and statistical mechanics on the other hand. He remarks that the interpretation of the square of the absolute values of the coefficients in the eigenfunction expansion of a wave-function as probabilities has never been made clear in quantum theory, and he suggests such an explanation based on a formal analogy. In his new

approach to statistical mechanics, the number of particles in a region of the phase-space is considered as an additive random functional.

In two lectures on coding and decoding, discrete processes are considered instead of continuous ones, and analogies to the earlier orthogonal expansions are treated. Coding consists of representing a given time series by a certain sequence of independent and equally distributed random variables. Decoding consists of the reverse operation, where each member of the sequence is determined by the 'past' of a given time series and conversely.

As stated in the foreword, the series of monographs, of which this is the first volume, is designed to make accessible research studies which are larger in scope than a paper in a specialized journal, but less ambitious than a finished book. It certainly has made a good start.

K. KRICKEBERG

WEATHER RECORDS OF THE WORLD

World Weather Records, 1941-50

(U.S. Department of Commerce: Weather Bureau.) Pp. ix+1361. (Washington, D.C.: Government Printing Office, 1959.) 4.75 dollars.

A FOURTH volume has been added to the series of "World Weather Records," this time over the imprimatur of the United States Weather Bureau and produced in collaboration with the staff of Blue Hill Meteorological Observatory, Harvard.

The three previous volumes, due to H. H. and Miss F. L. Clayton, were published in the *Miscellaneous Collections of the Smithsonian Institution* in 1927, 1934 and 1947. These year-by-year records of monthly values of temperature, rainfall and atmospheric pressure are an essential reference for all whose work is concerned with climatic behaviour and trends. The new volume, which principally covers the decade 1941-50, has been eagerly awaited. The data, contributed by the meteorological services of more than eighty nations, refer to some seven hundred points all over the world. In this volume ocean weather ship stations in the North Atlantic and North Pacific make their appearance for the first time, as do the remote islands of Marion, Heard and Macquarie in the Southern Ocean and the stations in the Falkland Islands Dependencies in Antarctica.

Another welcome feature is a great increase in the number of places for which long records have now been made available; notable additions in the present volume are Budapest (from 1780), Toronto and Hobart (both 1841-), St. Helena (pressures 1892-), Jan Mayen Island (1921-), as well as many tropical islands, extra places in the United States, Japan and elsewhere and data for Russian stations since the Revolution. There are also long tabulations of lake-levels, river-levels, dates of freezing and thawing, etc.

This is a fat volume, but the price has been kept encouragingly modest. It is to be hoped that the series will continue in this style, that further old records which have been, or are being, homogenized will be included in future volumes, and that some day the wide gap in the world meteorological network in the South Pacific will be filled by a weather ship.

H. H. LAMB