In conclusion, therefore, the relatively small importance of advective terms in the statistical scheme described is a measure not of their importance in the dynamic equations, but rather of some average rate of change of the wind field during the forecast period.

Yours very truly,
MORTON G. WURTELE

University of California
Department of Meteorology
Los Angeles 24, California

Reply

Dear Sir:

I wish to thank Professor Wurtele for his comments on my paper.

The remarks quoted from the final portion of my paper should have been phrased as a suggestion rather than a conclusion. Certainly Professor Wurtele has a firm theoretical basis for his point of view. However, empirical evidence from my paper and others indicates that the non-linear vorticity advection terms are not being incorporated effectively in either the dynamical or statistical forecasting procedures.

In reply to Professor Wurtele's comments, I wish to point out the results of the forecasts made by THOMPSON and GATES (1956), by numerical solution of both the barotropic and thermotropic equations using the initial data for the same 30 days (60 cases in January, 1953) and nearly the same area (North America) as used in my study. Table I of their paper states that the barotropic 500 mb forecast height changes had a mean correlation with the observed changes of 0.74 and had a mean RMS error of 229 feet per day. The 500 mb thermotropic forecast height changes also correlated 0.74 with the observed changes and had a mean RMS error of 231 feet per day.

Thus, the vorticity and thickness advection terms

$$J\left[(Z_5 - Z_{10}),\ \nabla^2 (Z_5 - Z_{10})\right]$$
$$J(Z_{10},\ \nabla^2 Z_{10}),\quad J(Z_5,\ Z_5 - Z_{10})$$

which appear in the finite difference form of the thermotropic equations but not in the barotropic equations added nothing to the 500 mb height change prediction when dynamical methods were used.

The statistical operators have not been applied to the study of the reduction of variance of the advection term $\overline{V}\dfrac{\delta\zeta}{\delta s}$ nor to independent data.

Sincerely,
DUANE S. COOLEY

Meteorological Development Laboratory
Geophysics Research Directorate
11 Leon Street
Boston, Massachusetts

REFERENCE:

THOMPSON, P. D., and GATES, W. L., 1956: A test of numerical prediction methods based on the barotropic and two-parameter baroclinic models. *J. Meteor.* **13**, pp. 127—141.

BOOK REVIEW

C. F. RICHTER, *Elementary Seismology*, W. H. Freeman and Co., San Francisco, 1958, 768 pp.

In order to appreciate the importance of this book, not equal to anything earlier in print, it is necessary to start with a few words about the author. Dr Charles F. Richter is Professor of Seismology at the California Institute of Technology in Pasadena, California. He took his Ph. D. in 1928 with a thesis in quantum physics and started his work at the Seismological Laboratory in Pasadena already in 1927, the year of its foundation. The intention was that he should work on theoretical problems, but he soon found out the necessity of observational data for a fruitful research. Since Professor B. Gutenberg came to the Laboratory in 1930, there appeared a long series of joint papers by Richter and Gutenberg, culminating in the famous book "Seismicity of the Earth". Richter is the father of the magnitude scale, first published in 1935, and later very much extended; this scale has placed earthquake statistics on a sound basis and is indispensable for simple energy computations etc. Richter has worked extensively on the seismicity in southern California both by seismogram studies and field investigations; he is famous for his detailed analysis of the large number of aftershocks of the Kern County earthquake in 1952. Few, if any, seismologists have an experience in interpretation of seismic records, comparable with Richter's. It is of extremely great

value to geophysics and geology that Dr Richter has now compiled his more than thirty year long experience in a book.

The title of the book appears a little bit modest to the reviewer, and reminds of the German "kurze Einführung" as a title of a book with at least one thousand pages. Richter's book is elementary in the sense that it is a very thorough treatment of the elements of seismology, and it can be read also by beginners without knowledge of the subject, or by people who do not like mathematical developments. On the other hand, it is an advanced treatment with a large number of references after each chapter (including very recent literature as well as more historical papers, the total number of references being around 790), and it is therefore indispensable for the professional seismologist in his research work. Dr Richter has a very extensive knowledge of the seismological literature, obtained by reading papers (sometimes with an assistant's help) not only in nearly all western languages, but also in Russian and other Slavic languages, sometimes even in Japanese. Much material, otherwise inaccessible to seismologists, has thus been presented in the book. Moreover, this presentation has been made with great care and selection, and Dr Richter has constantly used his critical attitude, based on his long experience. This is naturally of great help to the reader, especially as descriptions of earthquakes frequently contain many uncritical or misleading statements.

Seismology is taken to mean the study of earthquakes in all different respects in this book. Although several scientists like to include in seismology an equally thorough treatment of the physical properties of the earth's interior, this does not diminish the value of the book.

The presentation is very clear and attractive and mostly written in a charming personal style. Small anecdotes, scattered throughout the book, help to cheer up the reading. The division of each chapter into numerous smaller paragraphs, each with an appropriate heading, facilitates the reading considerably. A large number of good figures (in all around 190) illustrate the text.

The book is divided into three parts. The first part deals with the Nature and Observation of Earthquakes (24 chapters). This part gives a thorough treatment of all elements entering into the earthquake study—the nature of the motion; foreshocks, aftershocks, earthquake swarms; various effects of earthquakes; intensity, isoseismals, magnitude and energy; faulting; deep-focus earthquakes etc. There are also chapters on seismograph theory and practice, and on elementary theory of elastic wave propagation. Methods of locating earthquakes and the international collaboration in seismology have also received considerable attention. Practical and engineering aspects as earthquake risk and protective measures are dealt with in one chapter. Detailed description of a few sample earthquakes is given.

The subject of the second part is the Geography and Geology of Earthquakes (9 chapters). A description is given of the seismic conditions of our globe with much material, such as maps, taken over from the book "Seismicity of the Earth" and earlier publications, in some cases revised. Especially detailed study is made of the seismicity in California, New Zealand, and Japan to Formosa.

The third part consists of 17 appendixes, containing much information of use in practical work, such as transit-time tables, magnitude charts, methods of location of shallow teleseisms, near earthquakes, and of deep-focus earthquakes. Several basic, theoretical derivations, as calculations of velocities within the earth, reflection and refraction of seismic waves, elastic wave propagation theory etc are summarized. The intensity scales are given with notes and addenda; there is a table of angles of incidence; a selected list of seismological stations; lists of large earthquakes; and a useful chronological bibliography of investigations of earthquakes. In all, the book contains around 50 tables and ends with a very complete index, filling 30 pages.

In conclusion, I wish to emphasize the importance of this book not only for the beginner in the subject but also for the advanced student and the research worker. It will certainly prove to be of great value in teaching as well as in seismic routine work and especially as a reference book in future earthquake investigations. Also scientists of several other fields, especially tectonophysicists and geologists, will find much valuable information in this book, as e.g. on faulting and other tectonic phenomena.

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