to a heavy-water-cooled and -moderated reactor where one of the key design parameters is the value of the heavy water holdup. The practical advantages of steam reheating in the turbine cycle are not fully discussed. The lower low-pressure turbine exhaust moisture with reheat should give longer last-row blade life; however, the ability it confers on the turbine manufacturer to use standard low-pressure turbine sections by matching steam-inlet conditions for the L. P. turbine to those prevailing on conventional sets is of even greater importance.

The treatment of annual fixed charge rate on the capital invested is one area that causes some confusion. Two fractions are used, one called the investment charge and the other the normative effectiveness coefficient. These two fractions are added together to obtain the total annual charges on capital. It would appear that the investment charge is equivalent to interest rate and that the normative effectiveness coefficient is equivalent to depreciation plus taxes. A figure of $12\frac{1}{2}\%$ is quoted in the text for this coefficient; this appears to be very high compared to European or North American practice. However, it is a simple matter to substitute one's own figures for annual charge rate, although this, of course, will modify the conclusions as regards those optimum parameters that are cost dependent.

The book is noteworthy for its comprehensive treatment of a wide range of steam cycles including triple-pressure cycles, binary and supercritical cycles for use with organic coolants, and compound cycles such as the Field cycle about which little has been heard in recent years. The text also touches on various possible MHD cycles.

The translation is of good quality, only very rarely does any confusion arise. On page 152, reference is made to a mercury-cooled boiling-water reactor, whereas the context makes it clear that the reference should be to a boiling-mercury reactor. Although the chapter headings in the Table of Contents are broken down into subheadings, there is no index as such. The list of symbols used in the text, although extensive, is not complete and this does necessitate some hunting around to find the first reference in the text to the unlisted symbol.

These criticisms are of a minor nature compared to the overall value of such a comprehensive text on a topic that, for its importance, has hitherto received little published attention except in the form of scattered papers.

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March 10, 1966

About the Reviewer: Alan Wyatt received his graduate and postgraduate engineering training in England's Royal Navy. Since 1957, he has been principally in Canada, where in 1958-59 he developed the steam cycle used for the CANDU heavy-water reactors. During 1961, he worked in England on various cycles, including flashed steam and compound cycles, for gas-cooled and marine pressurized-water reactor studies. He is at present Proposals Engineer in the Power Projects Division of Atomic Energy of Canada Limited. Recently, he completed the steam-cycle studies for the 250-MW(e) heavy-water-moderated, boiling-light-water-cooled reactor proposed for Quebec. He is the author of a number of papers on various aspects of steam-cycle analysis, and he has lectured at the University of Toronto on thermodynamics for heavy-water power reactors.

Boiling Heat Transfer and Two-Phase Flow. By L. S. Tong. John Wiley and Sons, Inc., New York (1965). 216 pp. $14.00.

Due to the increasing necessity for advanced concepts and technologies in the nuclear and space industries, numerous studies have been, and will continue to be, reported on the subject of boiling heat transfer and two-phase flow. Significant contributions can be found in a wide variety of domestic and foreign journals, laboratory reports, technical progress reports, etc. Consequently, attempting to understand and keep up to date on progress in two-phase flow technology can often be a disconcerting and enormous task for engineers. The appearance of *Boiling Heat Transfer and Two-Phase Flow*, the first textbook to cover the general field, should greatly ease this task.

"The objectives of this book," Tong writes, are:

"1. To provide colleges and universities with a textbook that describes the present state of knowledge about boiling heat transfer and two-phase flow.

2. To provide research workers with a concise handbook that summarizes literature surveys in the field.

3. To provide designers with useful correlations by comparing such correlations with existing data and presenting correlation uncertainties whenever possible."

In the reviewer's opinion, the author has fulfilled all three objectives. He presents a most difficult subject, of which much of the material is inevitably semi-empirical in a clear and logical manner, always maintaining a sound engineering perspective. My only regret is the lack of any specific illustrations and the failure to include any problems.

The material in this book covers parts of a graduate course given by the author at the Carnegie Institute of Technology, Pittsburgh.

In the first chapter, definitions of boiling regimes, two-phase flow, boiling crisis, and flow instability are established. In the second chapter, pool boiling is described, including nucleation and dynamics of single bubbles, hydrodynamics of the boiling process, and pool-boiling heat transfer. Correlations of nucleate, transition and film-boiling data of water, organic fluids as well as liquid metals are presented. The third chapter is devoted especially to the hydrodynamics of two-phase flow, in particular, the flow pattern, the void fraction, and the velocity ratio. A discussion of phase, velocity, and shear distribution in various flow patterns is also included. Closely related to the flow pattern is the two-phase pressure drop, the topic of the next chapter. Here, a summary is given of available analytical and empirical models for calculating two-phase pressure drops in ducts as well as over-abrupt expansions and contractions. The chapter ends with a discussion on two-phase critical flow.

Chapter 5 introduces flow boiling. Here, nucleate boiling in flow, forced-convection vaporization and film boiling, and heat transfer in the liquid-deficient region are elaborated. The last two chapters in the book emphasize the boiling crisis and flow instability. Chapter 6 on flow boiling crisis summarizes theoretical, as well as empirical, approaches to the problem of "burnout." Designers are provided with practical correlations, and a discussion of parameter effects of flow boiling is included. The last chapter of the book treats the problem of instability, both from a hydrodynamic and thermohydrodynamic point of view. The basic thermohydrodynamic equations are presented, and flow instability in parallel channels and natural circulation loops are treated.

Some 400 references, covering the literature up to about 1964, are listed in the bibliography.

A copy of *Boiling Heat Transfer and Two-Phase Flow* should be in every engineering library. Not only beginners but also experienced designers of boiling equipment should find it a valuable source book. The nonspecialist will find it an excellent reference.

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March 8, 1966

About the Reviewer: Hans K. Fauske is on the staff of Reactor Engineering at the Argonne National Laboratory, Argonne, Illinois. He graduated from Bergen Technic School, Bergen, Norway, in 1957 as an industrial chemist. His graduate work was done at the University of Minnesota, Minneapolis, Minnesota, from which he received the master's degree in Chemical Engineering in 1959. In 1963, he received a Doctor of Science degree from the Norwegian Institute of Technology, Trondheim, Norway. Since he started his association with Argonne National Laboratory, he has worked primarily in the field of two-phase flow, with emphasis on boiling-water and liquid-metal reactor problems, and general two-phase heat-transfer and fluid-flow problems. Dr. Fauske is the author and co-author of numerous articles on the subject of two-phase flow.

Neutron Transport Theory. By J. H. Tait, American Elsevier Publishing Company, Inc., New York (1965). 142 pp. $6.00.

The purpose of this book is "to give an introductory account of the mathematical methods used in neutron transport theory." One might feel that Davison, in his book of the same title, had done this as of 1955 and that, hence, this book would contain new material and would provide a refreshing treatment of the older material. The latter is true. The book is brief (the 142 pages include three appendices, the references, and an index) and clearly written. In fact, this is the strength of the book: much of Davison and some new material are compactly summarized in a form that makes the book valuable as an inexpensive reference.

The book consists of eight chapters. In the first, fundamentals such as cross sections and scattering laws are discussed, and in the second the equations of neutron transport theory are derived. Chapters three, four, and five are devoted to solutions of the monoenergetic transport equation by exact, expansion (e.g., spherical harmonics), and diffusion approximation methods. In chapters six and seven, the energy dependence of the neutron distribution is considered, first with the neglect, then with the inclusion, of spatial dependence. The numerical methods described in the eighth chapter, the description of solutions obtained by Chebyshev polynomial expansions, some discrete ordinates results, and the discussion of the thermal neutron Milne Problem are not found in Davison's book.

Despite the relative lack of new material in Tait's book, it should be welcome by physicists and engineers who are concerned with reactor theory but do not want the mathematical detail of Davison's book. Tait relies heavily on the results of others and puts emphasis on the understanding and evaluation of these results. For instance, in Davison's book the treatment of the Milne problem is obscured by the lengthy derivations of the Wiener-Hopf technique, while in Tait's presentation, derivation is minimized and the physics of the problem is emphasized by the reportorial style. On the other hand, the stating of results does not teach derivation; and if Tait's book were used in an introductory course, much interpolation by the teacher would be required. Another difficulty with using the results of others is that undefined notations and unstated assumptions creep into the formulae. In the discussion of the age theory approximation, the symbol for the slowing-down length is not defined and the assumption of a pure scatterer (made in Davison's book from which the discussion is taken) is not stated. In fact, many definitions in the formulae of the book are made tacitly. For the reader with experience, this is a minor inconvenience, but for the uninitiated reader this omission can be confusing.

The main weakness of the book is that it is not current. The preface is dated 1963, and one suspects that much of the text was written earlier. Invariant imbedding is not mentioned at all, and the existence of the method of singular equations is indicated only by a footnote. The chapter on numerical methods describes S_n methods which date from the 1958 Geneva conference and serve only to give the flavor of the approach.

In summary, for the experienced, the book can be a valuable resume of transport theory methods as of about five years ago. For the inexperienced, the book can also be valuable provided liberal use is made of the references.

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March 10, 1966

About the Reviewer: Dr. Lathrop has been a member of the staff of the Los Alamos Scientific Laboratory since completion of his graduate studies at the California Institute of Technology in 1962. His current interests are in neutron and photon transport. He is a member of the Executive Committee of the Society's Technical Group for Reactor Physics.