work of Abbé le Maître and of Eddington, the problem may be more complicated than was believed previously. In fact, the universe may, perhaps, not at all possess a constant world curvature; and it must be admitted that the preponderantly positive radial velocities of the spiral nebulae are most simply explained by assuming the whole universe to expand, and to have nothing to do with the de Sitter-Doppler effect.

On the whole, the subject of the curvature of space is one in steady progress, the present state of which does not encourage to any display of orthodox convictions, but which may become of considerably more cosmologic importance in the near future.

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Determination of Orbits of Comets and Asteroids. By RUSSELL TRACY CRAWFORD. xi + 233 pp. McGraw-Hill Book Company, 1930.

A TEXT-BOOK designed for a college course of one semester to provide an introduction to the subject of orbit determination. The following subdivision of the book could be made: (*a*) Introductory chapters treating the motion of a body about the sun as attracting center, also including the subject of ephemeris computation; (*b*) Leuschner's method of orbit determination; (*c*) Merton's modification of the Gaussian method of orbit determination. Completely worked out examples and summaries of formulas for both methods and fourteen auxiliary tables are added.

As the author states in his preface, this work is different from other treatises on orbit computation. It is not intended to be complete, and does not, for instance, include the mathematical development of precession, nutation, special perturbations or least squares. "The definitive orbit" is very briefly treated, but logically, considering the fact that the book treats undisturbed orbits only.

Notwithstanding limitations set by the scope of the book, it is complete enough to be a very useful reference book. Those interested in more intricate problems, mainly of theoretical importance, which could not be fully treated, will find many helpful references to original publications.

This is the first time that a coherent presentation of Leuschner's method is published, after the original publication in Vol. VII of the Lick Observatory Publications. (Buchholz-Klinkerfues, 1912, gave little more than a set of formulas and examples.) Especially because many treatises on orbit computation entirely disregard the existence of other methods than the Gaussian we could have been satisfied with a book presenting Leuschner's method only. The fact that two methods, one representing the Laplacian and the other representing the Gaussian method, are given testifies to the broad attitude taken by Leuschner and his followers.

That Merton's development of the Gaussian method is chosen is not surprising. It has done away with a number of complications mainly due to the former necessity of adapting all formulas to logarithmic computation. The two methods offered are undoubtedly distinguished by theoretical clearness and adaptation to practical needs.

It would have been impossible within the scope of the book to include a critical comparison of methods of orbit computation. This is left to the student. The field which this book covers is very large, so that a selection was necessary. The author has made an admirable choice guided by his expert knowledge of the subject and experience in teaching it.

The book is beautifully printed; one can only wish that the subdivision of the chapters had been made more uniform and more distinct. The generous size of the pages (10 x 7 inches) has contributed much to its fine appearance, as many long formulas had to be included. The book is dedicated to Professor A. O. Leuschner, "a most stimulating teacher and inspiring director."

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN OBJECTIVE METHOD OF EVALUATING MUSICAL PERFORMANCE

IN the psychological laboratory of the University of Iowa we have developed instruments which enable us to record actual singing and playing accurately and quickly. This is done mainly with the strobophotograph camera designed by Professor Milton Metfessel[1] and recently improved by Tiffin and Reger. It virtually graphs two of the four elements of musical performance, namely, pitch and time. The other two elements, intensity and timbre, are not recorded.

A stroboscopic disk runs between the film and a neon lamp. The lamp flashes in frequency with the sound wave, and the film, moving past at a constant speed, registers a continuous picture of the stroboscopic effect. The stroboscope registers in terms of tenths of a tone but finer readings may be made in proportion to the steadiness of the tone.

The object of this note is to illustrate how this

[1] *Jr. Gen. Psychol.*, 2: 135–139, 1929.