world. It is the single stage upon which the whole physical drama is to be played, and Mach's principle (that the contents of the universe determine its laws) is one of its corner stones.

The book is divided into four parts, dealing respectively with kinematics, dynamics, gravitation and electrodynamics. Much of the first part, which contains an account of the now almost classic theories of time-keeping and equivalence, is undoubtedly of lasting value, whatever the ultimate fate of the theory as a whole, for it makes a notable contribution to our understanding of the meaning of time in physics. From it emerges the basic picture of the kinematic universe, a universe populated homogeneously by equivalent particle-observers possessing a common system of time-keeping, their congruent clocks being capable of agreed regraduations. This idea of obtaining alternative descriptions of the universe by the adoption of different time-scales is of profound interest, and has a significance more fundamental than the changes of time co-ordinates (usually physically undefined) permitted in general relativity. The set of particle-observers (the 'substratum') is the idealized representative in Milne's abstract world of the system of galaxies of the actual universe.

The passage from kinematics to dynamics is claimed, remarkably but not unreasonably, to be the only logical possibility, no appeal being made to empirical physical laws. The rest of the book abounds in striking results and bold assertions, most of them already known to relativists through their earlier publication in research papers. Only brief mention of a few of them can be made here. Milne deduces, for example, that the gravitational γ and Planck's h vary with the epoch; he claims to have resolved Hubble's difficulties in interpreting the red-shifts; he assumes no electron spin, his electrons being point-singularities, but deduces for them an effective radius equal to that of the classical electron; and he obtains, perhaps most remarkably of all, an equation for the spiral arm of a nebula, which possesses the unexpected property of turning back on itself after a certain number of convolutions, thereby suggesting a 'trail'. How far his results (assuming them applicable to the actual universe) are susceptible of observational test, I am not competent to say: nor do I feel able to venture opinions about the philosophical implications of his ideas. But I am sure that the work is too well reasoned to be lightly dismissed, and I would recommend it to the serious attention of physicists as well as to mathematicians.

H. S. RUSE

FARM MACHINERY

Machines for the Farm, Ranch and Plantation

By Arthur W. Turner and Elmer J. Johnson. Pp. xvi+793. (New York and London: McGraw-Hill Book Co., Inc., 1948.) 36*s*.

THE authors of this book have set themselves the difficult task of providing information on the host of different machines used in American agriculture. They have made a good start by adopting an intelligent system of classification of the equipment under the six headings of seedbed preparation machines, crop planting machines, crop tillage machines, harvest and harvest handling machines, mechanical power and transportation machines, and general service machines and barn and produce equipment. The chapters are well set out with clear headings to the sections and sub-sections, a wealth of good illustrations and with a useful summary at the end of each; in fact, the plans and foundations are excellent. It is unfortunate that the structure built on those foundations is not nearly so good.

Each machine is dealt with from three aspects—its selection, its operation and servicing, and its reconditioning. The part dealing with selection consists mainly of a description of the different available versions of each machine and of the extra fittings or attachments that go with it. The direct advice that the authors give to anyone faced with the job of choosing a machine is usually confined to a few brief and relatively uninformative sentences. For example, their advice to someone choosing a field cultivator is to "Select a size to match the power and with teeth or sweeps best suited for the purpose used". They do not, however, give the reader any idea of the amount of power that field cultivators need, nor do they describe the performance or applications of the various patterns of teeth or sweeps. The authors have, in fact, dodged one of the major problems facing farmers to-day—that of finding a matching set of equipment made up of units that will work smoothly together, and will allow all the farming operations throughout the year to be carried on with a constant and minimum amount of labour. The advice given on the operation, servicing and reconditioning of farm machinery is more complete. The practical farmer and tractor driver would probably have preferred, in addition to the details of setting and maintenance, more information than is given on the technique of working the various machines in the field, while the farm mechanic might ask for more practical instructions on the overhaul and repair of the machines described.

This book, which at a first glance appears to be so useful to everyone connected with agriculture, is disappointing. It gives a very good picture of the range of farm machinery available in the United States, and will be of more use to students and lecturers than to farmers and mechanics, or to those engaged in research in the field of agricultural engineering.

J. C. HAWKINS

CHEMICAL ESTIMATION OF WATER

Aquametry

Application of the Karl Fischer Reagent to Quantitative Analyses involving Water. By John Mitchell, Jr., and Dr. Donald Milton Smith. (Chemical Analysis, a Series of Monographs on Analytical Chemistry and its Applications, Vol. 5.) Pp. xi+444. (New York and London: Interscience Publishers, Inc., 1948.) 48*s*.

IN the whole area of chemical analysis few estimations are more important than that of moisture, and few in the past have received such casual treatment. That a volume of this size and character should be devoted substantially to one chemical method of estimating water is welcome evidence of the growing importance attached nowadays to precision in this field. The pendulum may, indeed, have swung a little too far; occasionally in this book