of Paris, on July 6, 1887, and which Le Chatelier republished in a second edition in 1904 together with several papers of later date, owing to the fact that the earlier publications were not generally available. This thesis, as Le Chatelier states in the preface to the second edition, has been the foundation for much subsequent work and it is classical in its importance, many of his conclusions having been confirmed by more recent investigations.

Mr. Mack's translation is a clear one and should be in the hands of everybody who is interested in the subject. It is to be regretted that he did not include the papers forming the fourth part of the second edition of 1904, all of which are of interest.

CLIFFORD RICHARDSON.

THE MODERN ASPHALT PAVEMENT. By CLIFFORD RICHARDSON. New York: John Wiley & Sons. Cloth. 8vo. Price, $3.00.

Mr. Clifford Richardson's book, "The Modern Asphalt Pavement," is by far the fullest treatise that has been published on the subject and is the first book that discusses the details of this industry. Without doubt, it will do much toward accomplishing what the author states in his introduction is the object of the work: "To demonstrate the nature of asphalt pavements and the causes of defects in them, to bring about improvement in the methods of their construction, and to show how this can be done."

The book, with the exception of one short chapter on asphaltic concrete, deals exclusively with the modern sheet asphalt pavement, the materials and the methods of construction, some views as to the cause of their failure and the methods of examining the materials used. The materials and methods of construction described, as is natural to expect owing to the author's present connection with the Trinidad Asphalt interests, are those principally applicable to this asphalt. While they are applicable in a degree to other brands of asphalts it is to be regretted that Mr. Richardson does not discuss a little in detail the modifications that are desirable with different asphalts.

The book is divided into parts, each treating of the different branches of the industry, while chapters give the details.

Parts 1, 2 and 3 discuss and describe in a general way the various parts of an asphalt pavement and describe the various materials used in the construction of these parts. Chapters III and IV

discussing the mineral aggregate and filler is one of the fullest and most lucid dissertations that has been written on this much neglected subject of sands and will prove interesting and instructive not alone to those interested in paving, but to engineers in general. Chapter XVI on the technology of the asphalt surface mixture should be read in conjunction with the above-mentioned chapters, as it discusses paving mixtures met with in practice and the relation of their behavior to the mineral aggregate they contain. It, however, should be treated more as a study than as a guide for the actual construction of a pavement, for, while the author apparently recommends, for all cases, what he calls his "standard sands," yet he admits that different sands, even of the same mesh composition, act differently owing to the character of the grain. It must be borne in mind, also, that asphalts with different physical properties require different sands; and that different streets, depending on the extent and character of traffic, require different sands. In Chapter V the author gives an elementary talk on the molecular construction of hydrocarbons intended as an aid for those not acquainted with chemistry.

In Part 3 the author takes up the discussion of the different asphalts and bituminous materials used in the paving industry and gives tests on the same.

It is to be regretted that the subject of bitumens as presented in this part of the book is dealt with so poorly, as it is the branch of the industry least familiar to the general profession. There are many misleading statements and discussions all through this part, and that the asphalts were treated with such inadequate justice can possibly only be explained by the fact that the author's long connection with the Trinidad Asphalt interests has made him more familiar with this material than the others. A few of the statements on the asphalts, drawn from either unreliable or inaccurate premises, are as follows: He states the difference between Trinidad Land and Trinidad Lake Asphalt are brought out by the fact that where 20 pounds of residuum are sufficient to make an asphalt cement when added to 100 pounds of Lake Asphalt, as much as 30 or more pounds of the same residuum are required to make a cement of the same consistency with Land Asphalt. This statement is not substantiated by the facts. The difference on an average is 5 pounds of residuum to 100 of asphalt.

On page 194 the author, in speaking of the asphalt on the More

Ranch, California, says: "This deposit of asphalt is of importance not on account of its size, but because the addition of perhaps a shovelful of it to each barrel of residual pitch has been used as a basis for the statement that the latter contains a native solid bitumen." The author so far forgets himself in this case as to state as a fact in a book which is supposed to be instructive a trade argument used by an asphalt company against a competitor. It is doubtful whether absolute proof of his above statement is obtainable, as there is sufficient evidence to the contrary to make it at least debatable, and even though he possessed absolute proof it ought hardly find place in a book such as this.

And still another case on page 236, in speaking of the bituminous sands of Santa Barbara County, Cal., he says: "The bitumen which these sands contain is in the form of maltha . . . ." In this he is mistaken. In all of the mines mentioned the bitumen is more or less soft but not maltha. The author has failed to mention the "New Mine" which is about 100 yards to the northwest of the Side Hill Mine and from which a hard material is obtained for mixing with the softer. The bitumen of this material is about as hard as that of Trinidad and by proper blending it is possible to obtain a pavement similar to any that can be produced by artificial means. Alluding to the pavements of this material in San Francisco the author says: " . . . . there is now a tendency to abandon this form of asphalt pavement and to construct surfaces from properly graded sand combined with filler and a suitable pure bitumen." It is not two years since the reviewer called on the city engineer and the asphalt chemist of San Francisco and looked over the pavements with them. They expressed the opinion that the bituminous sand pavements were superior to the artificially mixed ones.

In Chapter XIII Mr. Richardson associates together indiscriminately carefully prepared asphalts from California oils and residues of oil refineries and from the examination of this heterogeneous collection he draws the conclusion that asphalts made from California oil are not uniform and, as a rule, unsuitable for paving purposes. Yet good pavements made from this material are met with in many cities with climates ranging from that of Winnipeg, Manitoba, to that of Southern California.

There are many more instances that might be pointed out, though of less marked degree, of the author's seeming partiality.

Parts 4 and 5 are devoted to the technology of the paving industry. The former discusses the manufacture and preparation of the material at the paving plant ; the latter, the laying of the materials on the street. In these two parts is the best description of the technology of the paving industry that has been published and will without doubt, when carefully read, prove of considerable value.

Part 6 is a discussion of the physical properties of asphalt surfaces. The author here discusses radiation, expansion, contraction and the resistance to impact.

Part 7 treats of specifications and merits of asphalt pavements. The last chapter of this part relates to the action of water on asphalt pavements. The author stands practically alone among many experimenters in the interpretation of laboratory tests in this respect. Fig. 21, showing the action of running water on three different asphalt cements, is misleading, as the defects that can be noticed in the cut can not be the result of rotting or disintegration after so short a period of exposure to the action of water, but are due to physical deformities resulting from the flowing of the water over the samples. The value of the author's tests in exposing cylinders of asphalt mixture to water is detracted from by the samples being burnished from time to time, as described on page 439. This, of course, prevents the action of water on the cylinder in the laboratory, but has no bearing on what takes place on the street where water attacks a pavement from underneath and other portions not exposed to the burnishing action of traffic.

Part 8 is on the causes of the defects in and the deterioration of asphalt surfaces. As the author in all his conclusions fails to differentiate between the action of water on different asphalts the value of this part is unfortunately largely detracted from.

Part 9 is well worthy of consideration, as it emphasizes the importance of the control of the work by laboratory examinations. The author goes into the subject in detail of how samples should be collected and describes the methods employed in his laboratory for their examination.

The book, if carefully read, is a valuable contribution to the literature on this subject, but the reader should not accept the dogmatic statements of the author on the many debatable points, and should always keep in mind the author's point of view.

ALLAN W. DOW.