It is evident, however, that the author does not fully grasp all the principles involved in these machines, or he would hardly have spoken so disparagingly of the 'spring-governor' of Bond, which is unquestionably, when properly adjusted, one of the most perfect of all. In so full a treatment of the subject, one would naturally expect to find some notice of the ingenious arrangement by which the clock-work of the Dun Echt equatorial is brought under the electric control of the standard time-piece; but it is missing, though Grubb's less perfect apparatus for the same purpose is fully described.

The fifth chapter, dealing with micrometers, calls for no special notice, beyond the remark that it strikes one as a curious classification which treats of *chronographs* in this connection.

The sixth chapter is a short one, describing the different forms of helioscopes and solar eye-pieces, and the most convenient arrangements for making drawings of sun-spots and determining their position.

The seventh chapter is intended to be a full and elaborate description of the different forms of astronomical spectroscopes, with their accessories. It does describe and figure a great many; but there are several mistakes (as, for instance, on p. 656, where the temporary device which Professor Young employed in observing the eclipse of 1869 is said to have been used with a heliostat, and is spoken of as if it were now used at Princeton), and there is the capital omission of failing even to mention the use of diffraction-gratings in spectroscopic work. It strikes one as very surprising that the author should not have learned that for solar observations the grating has almost entirely supplanted the prism in many if not most observatories. The remarkable apparatus of Thollon is alluded to, but not described with any fulness.

The remaining chapters of the book treat of apparatus for celestial photography, photometry, and the measure of solar radiation.

Similar remarks apply to these as to the preceding. There are many excellent descriptions and illustrations, many important omissions, and a few mistakes. We call special attention to the fine representation of the most ingenious mounting — devised by Hansen, and constructed by Repsold — for the photoheliographs employed by the German transit of Venus parties, — a contrivance which we have never seen described elsewhere. But in the chapter on photography, neither the name of H. Draper nor of Common appears; and Rutherford's photographs of the spectrum are said (on p. 827) to have been made with an apparatus he never even saw, the instrument figured being a spectroscope which was used at Dartmouth college in attempting to photograph the solar prominences, while the description given is incorrect in several particulars. In the chapter on the measurement of radiation the apparatus of Pouillet and Secchi appears, but nothing later, — none of the instruments of Violle or Crova, and, of course, not the bolometer of Langley. The chapter on photometers is much better brought up to date.

On the whole, the book is rather a provoking one. There is a great deal in it of real value, collected from various more or less inaccessible sources, and very neatly presented; but the *lacunae* are serious, and a few detected mistakes leave a sense of insecurity as to accuracy in other details.

BURNHAM'S LIMESTONES AND MARBLES.

History and uses of limestones and marbles. With forty-eight chromolithographs. By S. M. BURNHAM. Boston, *S. E. Cassino & Co.*, 1883. 15 + 392 p. 8°.

THE separate crystals of our rocks, when they lend themselves to decoration in the form of gems, afford a capital opportunity for the book-maker. Superstition, tradition, a host of human activities, have gathered about them, that, in the hands of writers of skill, have been worked into very readable books. But, when the author of 'Limestones and marbles' tries to take something of the same book-maker's way with the coarser though still beautiful marbles, he leaves the field of thoroughly humanized things, and finds himself in a dreary sea of unrelated facts. A writer thoroughly conversant with the architectural history of building and ornamental stones could probably give us a book which would, from its connection with the most economic of the fine arts, be very readable. A skilled lithologist who would furnish us a careful discussion of the nature of those changes which give beauty, strength, and endurance to rocks, would thereby furnish us with a needed essay; but in this book we have no trace of these capacities, but only the ordinary patience of the devoted compiler.

As a piece of unwearied compilation, unenlivened with any higher quality, this is a very remarkable book. In the list of limestones of the United States we have evidence of a most universal but most uncritical ransacking

of authorities; for the element of personal knowledge is entirely wanting. Nor has the compilation the value it might have had if authorities had been quoted. Although the book is apparently by a New-Englander, he omits the limestones of Smithfield, R.I., and the serpentines of Lynnfield, Mass., — both interesting, though, as yet, little-used stones. Any personal knowledge of the subject would have supplied a host of such facts, which are not to be found in books, though well known to geologists. The same absence of personal knowledge leads to such misleading statements as that the fossils around Prague are identical with those of the same age in Scandinavia, Russia, Great Britain, and North America. While the book is padded with thirty-eight pages on classification of fossils, nothing is given to the arts of quarrying or of dressing stones, — most important and most relevant matters.

The chromolithographic plates are fairly well done: they fail to give the peculiar effect of depth or translucency, which is beyond this art, but which is the greatest charm of the finest decorative stones.

The style is not altogether bad, though it is frequently inverted; and the author often gets into the subject very much as John Phoenix 'backed the transit' into the plane of the meridian. Now and then it is strikingly epigrammatic, as in the following phrase: 'One of the caprices of nature is to anticipate the works of art.'

It is a pity that so much faithful labor should have been given to this work. The printing of the book, and the index, are very satisfactory. Despite its defects, the book will have a certain value to those interested in the subject; for, as a compilation, it is, in its way, remarkable.

A PRIMER OF VISIBLE SPEECH.

Visible-speech reader for the nursery and primary school. By Alex. Melville Bell, F.E I S., etc. Cambridge, *King*, 1883. 4 + 52 p. 16°.

The science of phonetics made, perhaps, its greatest advance through Bell's Visible speech, though it has by no means remained stationary since that book appeared. It is this system which this primer seeks to bring into practical use in teaching, and its alphabet is a great improvement over that which we now use. It cannot be said, however, that the phonetic analysis on which it is based has received in all respects the approval of phoneticians. With some changes, the vowel system has now won wide acceptance, but the analysis of consonants has met with serious objections; for instance, for such sounds as *f*, *th*, *s*, *sh*, in English. A discussion of the system itself would necessitate reference to recent work on phonetics, especially to Sweet's paper on Sound notation in the Transactions of the philological society for 1880–81, and to Sievers's Grundzüge der phonetik, and such a discussion would hardly be in place here. One may wish, however, that some of Sweet's changes of the Visible-speech alphabet could have been adopted. Still, the imperfections of the system might never attract a child's notice, and he would probably accept unquestioningly the signs given for *f* and *th*, without understanding why they were made to resemble the sign for *l*. For the scientific study of living languages, and of the phenomena of linguistic change, some such phonetic system as Visible speech, we may hope, will be agreed upon, at least provisionally, whether it is found of practical value in teaching children to read or not. The test of practice must show whether this ingenious alphabet will do better than other phonetic primers the work of teaching a child to read ordinary printed books. The primer is divided into three parts, — first, pictured words, containing pictures of a few common objects, with their names and some phrases; next, sentences in rhythmical form; and lastly, a vocabulary of common words arranged according to the initial sound, beginning with labial consonants, and ending with vowels. All this is printed only in Visible-speech letters. These three parts are preceded by some directions to the teacher; and at the end a key is added for the teacher's use, containing the usual forms in Roman type of all the words in the primer. Exclusive of the key, the whole contains thirty-five pages. At the beginning of the key are given a few 'notes,' which speak of the syllabic *l* and *n*, as in *castle*, *listen*, and of the glides, that is, the vowel vanishes, or final diphthongal elements in such words as *hear* (the sound represented by *r*), *day*, *go*. It must surprise an American student of phonetics to see that American pronunciation is credited by Mr. Bell with pure long vowels in the last two of these words, instead of with diphthongs, especially if his own experience and observation with foreign languages have shown him how hard it is for most Americans to learn the pure long sounds of *e* and *o* as pronounced on the continent of Europe. Possibly the American vanishing vowel in these cases is less prominent than in England, and it may be that some Americans do pronounce