cally it would probably increase as the subdivision of arcs is carried on. There are some statements in the note referred to, which appear to be misleading. To quote:

"Even if the division error of any given line could be determined with complete precision with the telescope pointed at the zenith, this division error would not hold true when the telescope is pointed elsewhere. Nor is this brought about by flexure alone. It is found that if we determine the division errors of a straight scale, these errors are completely changed when the scale is reversed end for end. No doubt unavoidable difference in the illumination and the eye of the observer are responsible for these unfortunate facts. But facts they are, and the cause of much wasted labor."

While the measurement of the division errors of a straight scale might not hold true if the scale were reversed end for end, this apparently damaging condition has nothing whatever to do with the measurement of the division errors of such a divided circle, since it cannot possibly be reversed; but is always read, facing it, in the same position.

As the instrument is moved to various settings, any single division passes under the various microscopes, and is read at various inclinations to the vertical, under various conditions of illumination, and to make the illustration as wide as possible, by various observers. The reading at any microscope will be affected by all the conditions of phase of that microscope, and by the personal equation of the observer, which may be, and probably is, peculiar to that microscope.

But there is no reason that these conditions should differ for the various divisions, which come in succession under the same microscope, or set of microscopes. In every case of star observation, or of determination of graduation error, the difference is measured between a reading of the circle at the required setting, and some standard reading.

Personal equation and phase should affect each reading alike, and should be eliminated from the results.

As to the effects of differences in the illumination and the eye of the observer, if they exist, they must be equally injurious to all observation with this instrument, as, in fact, they must be in every class of observing. Such sources of error fall within the class admitted as accidental; with proper care and well designed illumination, they are not believed to be large enough to invalidate the results obtained with fine instruments in astronomy of precision.

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SCIENTIFIC LITERATURE.

Elements of Geology, a text-book for colleges and for the general reader. By Joseph Le Conte. Fourth edition, revised and enlarged, with new plates and illustrations. New York, D. Appleton & Co. 1896.

For nearly twenty years Le Conte's Elements of Geology has stood side by side with Dana's Manual in the working libraries of American geologists and teachers. It has found equal favor in the class-room and the study room, and has been widely read by the cultured layman. Holding this enviable position, it needs neither introduction, encomium nor criticism; but the appearance of a new edition may rather serve as an occasion to enquire what are the qualities on which its success depends.

I conceive that one of the first of these is a wise choice of material. The author is fortunate in possessing the power to select the more essential and ignore the less essential, so that the principles he expounds are not obscured by clouds of detail. Moreover, he devotes all his space to his proper theme, the science of geology, assuming, on one hand, that the reader has all necessary knowledge of physics, chemistry, astronomy, meteorology, biology, and even mineralogy, and not undertaking, on the other, to teach him either the technology of the professional geologist or the economic application of geologic results.

Of equal importance, perhaps, is the order of presentation, which deviates somewhat from the strictest system so that it may follow lines of least resistance. One who writes on a complex subject is always embarrassed by the fact that the easy explanation of each part seems to require the previous explanation of some other part; and in geology this contest for priority lies between processes of change and the struc-

tures, etc., which result from change. Le Conte gives a general outline of processes under his first heading, Dynamical Geology, but reserves much of their amplification to be introduced under Structural Geology in explanation of the principal products of change, namely, rocks, rock structures and mountains.

A few subjects are developed by the presentation and discussion of alternative theories, and these serve the important end of illustrating the method of scientific progress. Others are not carried beyond the safe ground of established result, and yet others are confessedly treated from the personal standpoint of the author, who supports his views by argument. For the professional and critical reader the passages last mentioned are doubtless the least convincing and satisfactory of the treatise, but they strengthen it in another way by exhibiting the author in his proper character as an able investigator and original thinker. Moreover, the literary style, which, albeit, is ever lucid and direct, often assumes the characteristics of a spoken address, so that the reader is distinctly conscious of the writer's individuality.

Only five years have elapsed since the last revision of the book, and the amount of change now introduced is not large, though enough to require a complete resetting of type. Perhaps it is best expressed by saying that in a total of one thousand figures sixty are new. Among the subjects amplified are earthquakes, igneous rocks, geologic climates, trilobites and Mesozoic and Cenozoic vertebrates. The Cambrian is given higher taxonomic rank than before, but the Algonkian is not recognized.

It is, of course, easy to pick flaws, for the broadest investigator and most scholarly student is not omniscient. Our author tells us that tideless waters are essential to the production of deltas, and the flux and reflux of tides to the creation of estuaries. Even Chesapeake Bay and the fiords of Norway are ascribed to tidal action, and the function of submergence in the origination of estuaries is almost ignored. Not only is the old view retained, that gneiss is a stage in the making of granite, and that the Archean consists essentially of metamorphosed sediments; but no mention even is made of the view prevalent among modern investigators, that gneiss is usually altered granite, and that the Archean complex consists largely of altered igneous rocks. The student of mountain dynamics could wish that the author's hypothetic explanation of the Basin ranges were stated with less confidence; the physiographer that crude sketches by early explorers of the Grand Canyon of the Colorado and the Mauvaises Terres were replaced by more realistic drawings; and the biologist that a more modern classification of living forms were employed.

But these and other blemishes may freely be forgiven to a book that sets forth the broad generalizations and fundamental principles of its particular science in orderly and attractive form, and at the same time illustrates and embodies the true and essential spirit of all science.

G. K. GILBERT.

The History of Mankind. By PROF. FRIEDRICH RATZEL. Translated from the second German edition by A. J. Butler, M. A. With introduction by E. B. Tylor, D. C. L., with colored plates, maps and illustrations. Vol. I. pp. 468. London and New York, Macmillan & Co. 1896. Price, $4.00.

Prof. Ratzel, of Leipzig, has achieved a well-earned reputation as a writer and teacher of geography in its relation to man and human culture. His chief work, 'Völkerkunde,' appeared in 1885, and some years later a second edition was called for, of which the above is a translation. It is a book intended for the general public rather than the scientific student, and in that respect will prove less satisfactory to the latter than, for instance, Prof. Waitz's 'Anthropologie.' Ratzel does not give references to authorities for his statements, thus avoiding notes and the discussion of small points, but leaving his reader without an aid to further researches. His style is clear and pleasant, and the translator has, as a rule, done his part of the task cleverly, and given an easy English rendering to the original. The illustrations are abundant, accurate and well printed, and aid materially in bringing the descriptions home to the mind.

This first volume includes two 'Books,' one on the principles of Ethnography and the second on 'The American-Pacific Group of