

SCIENCE

NEW YORK, FEBRUARY 16, 1894.

AN EXERCISE IN GEOLOGY.

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A MOST profitable training to be had from the study of geology is found in the interpretation of geological maps and sections with a view to reconstructing the geography of the continent in various periods of geological time. Our text-books usually give the student such reconstructions ready made, but it is safe to say that they do not mean very much to the average student; he does not probably get farther into the matter than to wonder how anybody knows that there was an extended land mass in the Sierra Nevada region, for instance, during Palæozoic time when the geological map shows the region mostly covered with Jura-trias rocks.

As data for this exercise I compile, from as recent data as I have at hand, a geological map of the country and a considerable number of geological sections. For a blank map I use the map "Form C" of the United States Weather Bureau, 19×24 inches in size.

The geological map should be a simple one, omitting many small areas; it is not worth while, for example, to show the narrow lines of Cambrian and Carboniferous rocks bordering the Rocky Mountains; their presence will be disclosed by the geological sections; besides they would be rather misleading than otherwise, since they seem to imply that the Silurian and Devonian are there missing from the series. Nor should the intricacies of Appalachian geology be represented. I generally content myself with showing a very narrow line each of Cambrian, Silurian and Devonian bordering the Archæan area of this region on its western side.

I use one color for each period, as now recognized by the United States geologists, omitting, however, the Pleistocene or at least the drift deposits. For pigments I use the anilin dyes, approximating as nearly as convenient to the colors adopted by the United States Geological Survey, as follows:

- Neocene—Yellow analin tinted slightly with rosin.
- Eocene—Yellow analin.
- Cretaceous—Methyl green shaded with yellow.
- Jura-trias—Methyl green.
- Carboniferous—Blue analin.
- Devonian—Gentian violet darkened with common ink.
- Silurian—Gentian violet.
- Cambrian—Rosin.
- Algonkian—Yellow tinted with rosin.
- Archæan—Bismark brown.

On the same sheet with the map is presented a generalized section across the continent, on the 40th parallel, showing the superposition of the rocks of the several periods, their relative thickness in different basins, their folding in mountain regions, their conformity or unconformity and some of the more extensive faults which the section crosses. This section along the 40th parallel

happens to be an unusually instructive one, crossing, as it does, surface exposures of every formation, except perhaps the Algonkian, and revealing the geological history of our principal mountain systems; but in addition a number of local sections are needed to make clear the history of certain regions, especially where late formations entirely conceal earlier ones. I have represented sections across the Green Mountains and the basin to the east of them, across the Connecticut Valley, through one or more of the Great Lakes to show that they are erosion valleys, through the Black Hills, the Uinta range, the Texas Archæan and Algonkian, the Grand Cañon region, etc., etc. These sections should be on the same sheet with the map and numbered to correspond with lines on the map indicating their location.

Some of these sections must, it is true, be more or less hypothetical, but they should not be mere guesses; let the guessing be done, if it must, when we come to reconstruct the geography of the continent. Portions of the north-western and southwestern United States are as yet so incompletely known that I do not attempt to include them in the map even.

Finally some lines of off-shore soundings should be drawn around the map to indicate where the real borders of the continental plateau lie.

In the first place each student should make for himself an exact copy of the map and sections. This will not be a very laborious task, as a blank map can be placed over the other against a window and the division lines copied through. By the process of drawing and coloring the map the student will get a better acquaintance with it than he could in any other way.

The classes are now prepared to trace the growth of the continent from period to period. Let them make at least one map showing the land and water for each period. Shade the land one color and leave the oceans and submerged portions of the continent blank; where the coast lines can be located with reasonable confidence, indicate them by the water-lines ordinarily used on maps; where they are quite hypothetical use dotted lines or some similar device; but let every student *make his map*, even though in places it must be largely conjectural. The smaller weather bureau map 9×12 inches will perhaps be better suited to this purpose.

I have been very much interested to see how, by this process, a geological map from being, to many a student, a meaningless patchwork of colors becomes significant and intelligible, almost a geological history in itself, in which the student can see in imagination not only the gradual extension of the continent southward from Canada during the earlier periods, but also the sinking archipelago in the west with only its higher summits finally peering above the engulfing seas.

I have suggested one map for each period; but there are some portions of the geological story so interesting on account of their widely changing conditions that several intermediate maps are most instructive: this is especially true of pre-Cambrian and early Cambrian times and also of the passage from Carboniferous through

Permian to Juratriassic times. For the former we are as yet poorly off for data, especially in Algonkian times; for lower Cambrian I send the student to Walcott's map in Bulletin No. 61 of the United States Survey, showing the occurrence of lower, middle and upper Cambrian deposits at various points; or better reproduce the map and show on it at the same time the Archæan exposures, so that it may be evident in what basin or valley each Cambrian section lies; then the mapping of the continent, first in earlier Cambrian and then in later Cambrian times, presents a very instructive picture to the mind's eye of the waters returning from their long retreat, after Algonkian times, into the ocean basins and gradually encroaching upon the continent, first filling the valleys along the borders, and finally invading the heart of the continent itself. The retirement of the waters in later Carboniferous and Permian times is an equally interesting spectacle.

Nor is the mere mapping of the land and water all that can be done. The question will arise as to what sort of a land it was: was it level or mountainous? How high did the Rocky Mountain islands and other lands rise above the sea? Such questions can be answered approximately at least by a study of the sections if they are carefully drawn. The student will discover, for instance, that the Archæan rocks of Nevada towered up high enough not to be submerged by the 30,000 feet or more of Palæozoic sediments that were deposited in the valleys to the eastward; in other words that mountains higher than any now existing lie buried under the modern Sierras. The student may represent these on his Palæozoic maps and indicate their gradually decreasing height from period to period.

Something, also, can be done at locating the old drainage systems of these early continents. In many cases it will evidently be safe to infer that the modern rivers are in the same old channels, especially in driftless regions; in other cases the pre-glacial history of rivers has been made out; a map of the pre-glacial drainage of the great lake region, like that in the *American Geologist* for Feb., 1891, for example, may be reproduced and hung on the wall, where it may be used in locating the probable course of the rivers of that region, in the various periods with which the class has to deal.

I wish that some one who is competent to do it would give us a handbook of elementary geology, which should consist largely in the presentation, by means of maps, sections, rock columns, tables and text, of such facts as the student could use in developing by laboratory methods his own "geological story briefly told."

THE BASIS OF SPELLING REFORM.

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MANY efforts have been made, and renewed from time to time, to correct the anomalies of English spelling; but, for the most part, these efforts have been resultless, except to intensify the prevailing sense of needed amendment. Strangely enough, the first requisite for any improvement in spelling has generally been lost sight of—namely the improvement of the ALPHABET. We have to write *g*, we have to write *h*, we have to write *n*, we have to write *s*, we have to write *t*, in thousands of cases where there is no *g*, *h*, *n*, *s*, or *t* to be pronounced. On account of a defective alphabet we are compelled to use unsounded letters to denote unrepresented sounds. For example, the consonant in the syllable *ing* has neither *n* nor *g* in its sound; the consonant in the syllable *ish* has neither *s* nor *h* in its sound; the consonants in the words *oath* and *they* have neither *t* nor *h* in their sounds; and these two sounds,—while as different from each other as *s* and *z*, *f* and *v*, *p* and *b*,—are both denoted by the same

letters, *th*. With such glaring defects in the alphabet, any attempt to improve orthography by merely dropping redundant letters is but trifling with the subject. A workman must have appropriate tools, yet we expect our literary workman to dispense with a large proportion of his most necessary implements, and to spell forty sounds with little more than half that number of letters. We must commence our spelling reform by providing the means of writing our unrepresented sounds. Of these there are six, among consonants, as heard in the words

sing, wish, pleasure, oath, they, why.

When we shall have furnished the alphabet with representative letters for these elementary sounds it will be time enough to attend to the minor discrepancies in the writing of vowels. All the amendment that can be hoped for in the latter respect—without multiplication of new letters—will be brought about by the application of one rule, namely: OMIT ALL PHONETICALLY DISPENSABLE, OR SILENT, LETTERS. This rule will, without specific detail, take *a* from *head*; *e* from *have* and *give*; *i* from *friend*; *o* from *foff* and *people*; *u* from *build*, etc. The rule has thus the advantage of simplicity and comprehensiveness, so that it may well take the place of the twenty-four rules of the philological societies, which only amount to the same precept "writ large."

Of the two classes of faults in spelling—deficiency and redundancy of letters—the former is by far the more serious and should be first rectified. Redundancies can be dropped at any time.

The one only drawback that can be urged against extension of the alphabet is that printers will require six additional types. But this objection is neutralized by the consideration that the trifling expense of additional types will be largely offset by the working economy of making six letters do the present duty of twelve.

The new consonant letters may be so designed that they will make but little alteration in the aspect of words, and so will be intelligible at a glance to every reader. The suggested forms introduced in WORLD-ENGLISH exemplify this fact, but in that system every word is made phonetic for "World" use. The present proposal limits inaugural improvement to the provision of letters for unrepresented sounds. Other improvements may safely be left to work themselves out by degrees, but there can be no radical improvement in spelling while we lack letters to represent one-fourth of the consonants in our language.

The attention of Congress has recently been again called to this subject; therefore the movement is opportune for its discussion. Let America take the initiatory step, and Great Britain and the English-speaking world will follow. The "initiatory step" will consist simply in an enactment that the Public Printer shall henceforth use prescribed forms of single letters to represent the six simple sounds enumerated above; and that he shall discontinue the use of the double letters now employed for the same purpose.

This is the true basis of SPELLING REFORM.

—Sydney H. Vines, Fellow of Magdalen and Sherardian Professor of Botany in the University of Oxford, is about to issue a "Student's Text-book of Botany," based upon Professor Prantl's "Lehrbuch der Botanik," but with the scope of the work so extended that, while retaining all that has made it of value to beginners, it will be more useful to those engaged in advanced study. The number of pages has been doubled by additions to all four parts of the book, but more especially to Part III., dealing with the classification of plants. The whole book, moreover, has been so revised as to render the present essentially a new and distinct work.